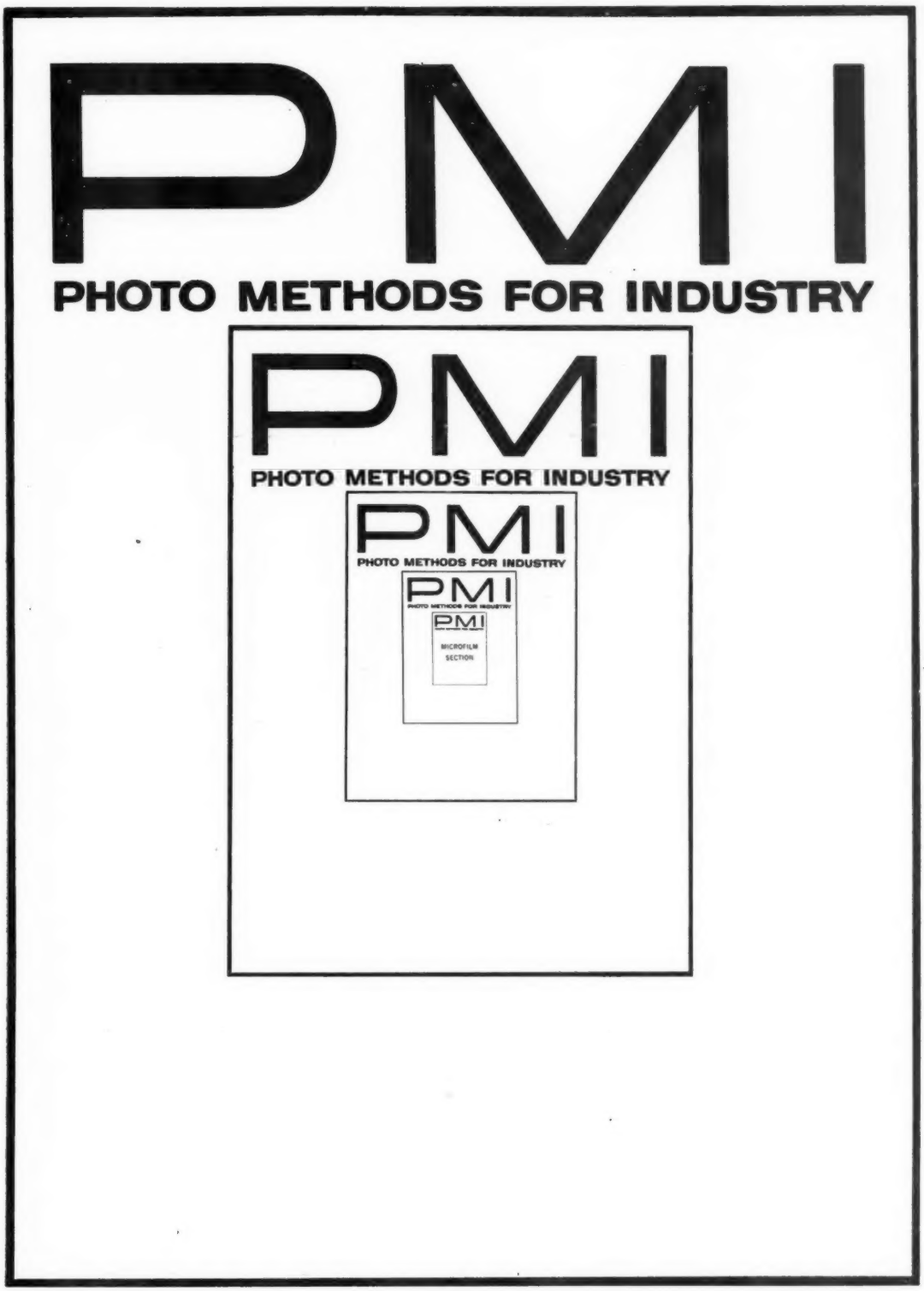
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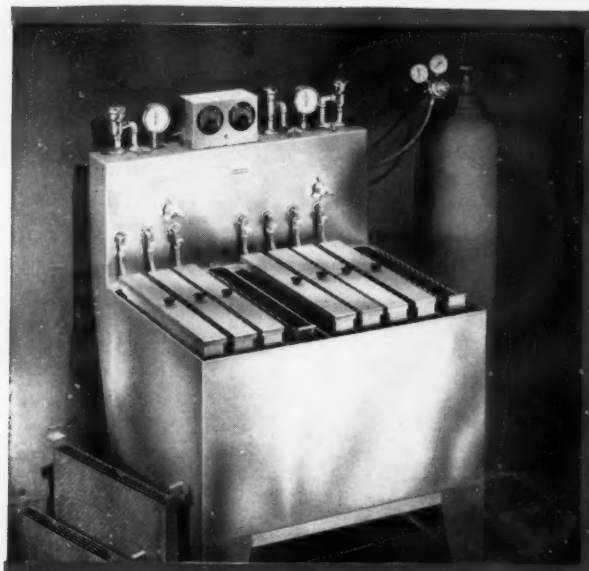
SECTION

why calumet color processors turn out clean sparkling prints up to 20" x 24"

1 Nitrogen Burst agitation and temperature control assure clarity, uniformity

2 Calumet Streak-Free Processing Basket* eliminates all "screen marks" on prints



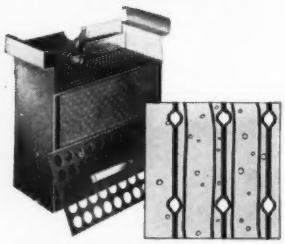
CALUMET'S tight light-proof covers enable you to process your color prints in normal room light!

←16 x 20 Calumet Color Processor for 16 x 20, 11 x 14 and 8 x 10 color prints. 3½ or 10 gal. capacity

11 x 14 Color Processor for 11 x 14, 8 x 10 color prints, 3½ gal. tank capacity

20 x 24 Calumet Color Processor for 20 x 24 prints. 10 gal. tank capacity

Special Calumet Streak-Free Processing Basket



Calumet Processing Basket, divided by partitions in which prints are placed, has curved protrusions on each partition wall which keeps print from touching wall. Fluids pass between paper and walls when solution is agitated. This unique basket carries a guarantee—never to cause marks on prints. Cut-away top makes it easy to take prints out.

Now you can process color prints in sizes 8 x 10, 11 x 14, 16 x 20, and 20 x 24 inches...and be SURE they will be wonderfully bright and clear

Among the many reasons why Calumet Color Processors get such superior results in processing color prints are the advance features you find ONLY in Calumet equipment. These features are illustrated and spelled out in a fascinating 12-page color processing catalog. You owe it to yourself to read and keep this booklet on your reference shelf. It opens wide the informative door to the new world of color. Get your copy now!

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*patent applied for

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Furthermore, Cormac Chemical Corporation has augmented the staff of its Technical Service Department, so as to provide, at a moment's notice, complete and up-to-date information on the use of UNIBATH combined developing-fixing solutions with all types of sensitized materials now on the market.

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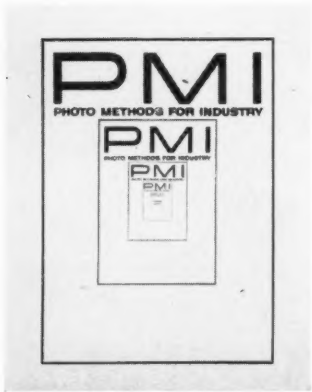
MARCH, 1960

VOL. 3 NO. 3



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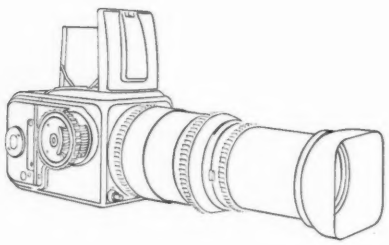
500C with magnifying hood, 60mm wide angle lens, 16 exposure magazine, exposure meter winding knob.

How many cameras does a photographer need?



500C with 250mm telephoto lens, sunshade, exposure meter knob.

If your answer is one, you've never loaded your camera with black and white film and immediately come upon a spectacular red fire.

Or found a crowd that kept you too far from a scene for your normal lens to get it.

Or found that your viewfinder couldn't focus accurately enough to handle a microscope shot.

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A special precision camera that can be set up in seconds for virtually every shot known to photography is yours with the Hasselblad.

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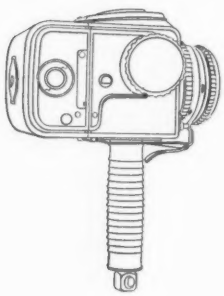
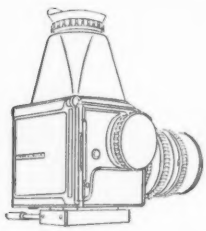
Lenses? Your choice of four, all made by Carl Zeiss of the world's best optical glass, each fitted with Synchro-Compur shutter, automatic diaphragm and coupled EVS system.: 1. Distagon 60mm f/5.6 Wide Angle. 2. Planar 80mm f/2.8 Normal. 3. Sonnar 150mm f/4 Telephoto. 4. Sonnar 250mm f/5.6 Telephoto.

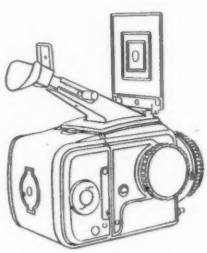
500C with camera grip with release, normal 80mm lens.





500C with magnifying hood, single cut film adaptor and holder, normal 80mm lens.

500C with prismatic sports viewfinder, normal 80mm lens.



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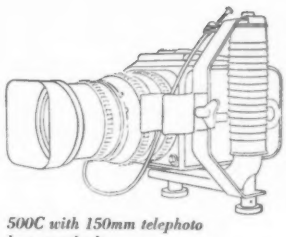
500C with magnifying hood, extension tube C, normal 80mm lens.

larger cameras. The EVS system, in addition, automatically adjusts aperture to any shutter speed after one setting for the correct exposure. Diaphragms can also be stopped down manually. Full synchronization for regular and electronic flash, of course.

How many cameras do you need? All that a Hasselblad can give you.

With Zeiss Planar 80mm f/2.8 lens and standard reflex viewer, $489.50. Write **Dept. HPM-3** today for literature and name of your nearest Hasselblad dealer. *All prices include F.E.T. where applicable.*

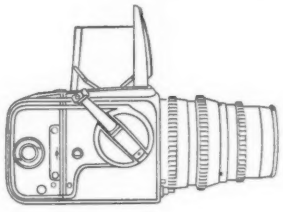


500C with 150mm telephoto lens, sunshade, flash gun bracket.

Viewers? Your choice of four: 1. Standard ground glass reflex viewer with pop-up magnifier for critical focusing. 2. Sports viewer with reflex prism. 3. Sighting type sports viewfinder. 4. Magnifying hood for microphotography.

Accessories? Your choice is almost endless: exposure meter winding knob, flash gun holder, proxars, extension tubes, filters and many more, precision-matched to the Hasselblad 500C.

Picture quality with a Hasselblad is such that many studios find its color rendition and detail resolving power equal to



500C with 150mm telephoto lens, fast winding handle, superslide magazine.

500C with sports finder, camera grip, normal 80mm lens.

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F.Y.I.

As children, we were taught that ingenuity, like clean-living, is its own reward. Nevertheless, we have always felt that something more tangible than a feeling of accomplishment would add frosting to make nibbling at the cake of virtue much more appetizing. Therefore, we are happy to report that the first Lyman Thurston Ingenuity Award went to Harvey Royer of Telechron, Ashland, Mass. Honorable mentions went to Ray McCann of Cambridge Air Force Research Center and Frank Hartley of Edgerton, Germeshausen & Grier. The award, to the industrial photographer who has contributed most to progress in the field, was presented at the Third Annual New England Industrial Photographers Trade Show, Dedham, Mass. Ed Purrington of Ford made the selections. Hail to thee, ingenious craftsmen of the camera.

From the grove of academe

Ingenuity is fine but it works better coupled with education. Here are some interesting and worthwhile activities from the academic world (photographic division).

A two-day short course in photojournalism will be held Mar. 25-26 at Michigan State's Kellogg Center. According to program director George Hough, the course will attempt to develop a better understanding of the technical phases of photography in addition to emphasizing interpretive factors. Information on the course, which is being sponsored by the M.P.P.A., Michigan Press Association and the M.S.U. School of Journalism, may be had from Michigan State University, East Lansing, Mich.

The PSA is offering an $825 scholarship to the Department of Photographic Technology at Rochester Institute of Technology. Applicants must be high school graduates able to meet RIT admission requirements. In addition, up to six photographs must be submitted as proof of the applicants' photographic ability. Deadline is May 1. Details from Miss Harriet L. Dieter, PSA Scholarship Committee, 2112 Inchcliff Rd., Columbus, Ohio.

An RIT scholarship is also being awarded by PPA. This is the fifth annual award. Deadline for applications is April 1. Details are available from Professional Photographers of America, 152 West Wisconsin Ave., Milwaukee 3, Wis. The Trustees of the Winona School of Photography will make the award.

Speaking of Winona, now in its 39th year, the 1960 list of courses is available. Inquiries about the school go to PPA at the address above. Ask for the Complete Brochure and Schedule of Events. Of interest to industrial cameramen is the seminar on "Industrial Photographic Management" (Aug. 21-27) and "Small Camera Photography" (June 19-25). Actually, since many of the plant man's problems are similar to the studio owner's, some of the courses can be quite useful, even though not specifically directed to the industrial field.

The 19th Annual Kent State University Short Course in Photojournalism will be held June 14 to 17. Lloyd Jones, chief photographer of the Youngstown *Vindicator* will be program chairman. Director of the course, which will cover press, industrial and television photography, is Edward Cliney, instructor of journalism at Kent State. For information, write the School of Journalism, Kent State University, Kent, Ohio.

The National Microfilm Association will stage its 9th annual convention April 19 to 21 at the Statler-Hilton, New York.

A four-day seminar and workshop on "Animation Film Technique" is being offered by Florman & Babb and the Warren C. Portman Co.

There are only 100 places for the session which will be held in June at the Hotel Manhattan in New York. Leading animators will participate including Ernest Pittaro, production supervisor for TV films and author of *TV and Film Production Data Book*. Other leaders will include Warren Portman, Charles Lipow and Arthur Florman.

For details, write Mr. Lipow at Florman & Babb, 68 West 45th Street, New York 36, N. Y.

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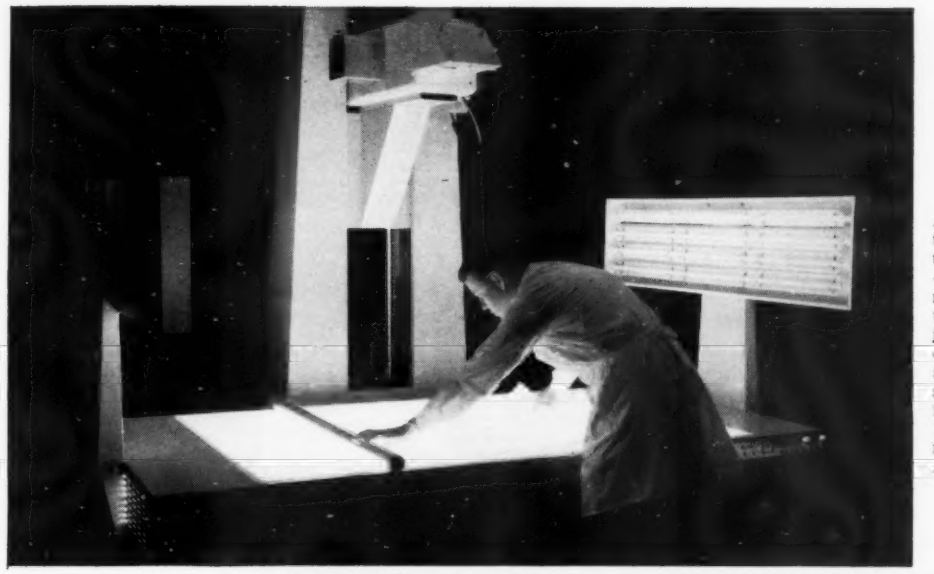

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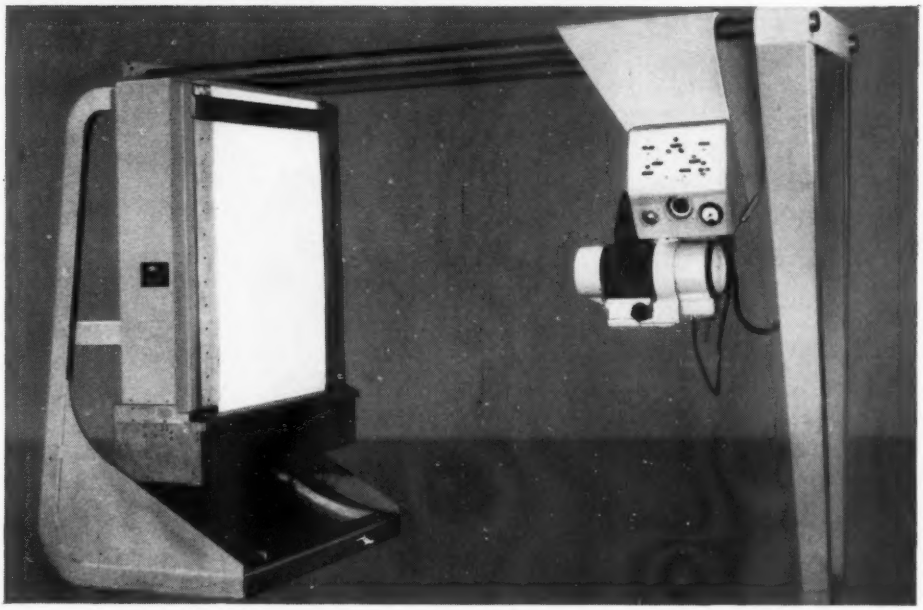

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REPRODUCTION TRENDS

Sharp cloth intermediate prints can now be made with present diazo process equipment by using Post 208TC (black) or 209TC (sepia) cloths.

Now widely accepted . . . a diazo cloth with denser black image

One of the big stumbling blocks to more widespread use of intermediate papers and cloths has been the lack of a good, sharp, dense *black* for ammonia process equipment.

When Post laboratories licked the problem in intermediate *papers* with the introduction of an improved Vapo Black, it opened up new challenges. There was a need to develop similar superior image densities on more permanent base materials. Among these newer Post products which are now widely accepted are 208TC (black) and 209TC (sepia), two Vapo Intermediate Cloths with outstanding characteristics. Here are cloth reproductions with truly dense images that have proven remarkably permanent after extensive tests.

Using 208TC or 209TC Vapo Cloth, you can produce highest quality cloth intermediates with your present diazo process equipment. It is a convenient, low cost, single-operation method requiring no negatives.

Tough intermediates save originals

The durable, premium quality white tracing cloth base stock holds up well even after prolonged filing. In accelerated aging tests, Post 208TC and 209TC prints were held at 100° C for 20 hours. At the end of that time there was no evidence of bleeding . . . while transparency loss was minor.

Interestingly enough, printing speed (making the intermediate) of both products is unusually high. Even more important, there is no sacrifice of image density to obtain this high speed. Prints are still strong, clean and dense. Similarly, printback speed is fast with crisp prints the result every time.

Prints better than originals

In many instances, the "contrasty" emulsion makes it possible to increase the intensity of an original drawing and actually make the intermediate better than the original. But in any case, a print on 208TC or 209TC has the sharpness, contrast and density that are the marks of quality reproductions.

For detailed information on 208TC and 209TC write Frederick Post Company, 3660 North Avondale Avenue, Chicago 18, Illinois.

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F. Y. I.

(*continued from page* 8)

That lonesome road—again

Generally our gremlins used to attack one at a time, causing one error here, one there. For the January 1960 issue, however, they changed their tactics, making a mass raid on our Photo Instrumentation column. Here are the results of their work. First, the electronics technician is Hisashi Fujimoto, not Misashi. Secondly, the photo used for the test of CDS was a moon shot, not a mood shot. Finally, CDS scans, rather than televises. Even the printer fell into the spirit of gremlinism, transposing nine lines at the end of the column. Does anyone know a good gremlin exterminator?

This item is not exactly photographic but it is the most intriguing bit we've seen in a long time. A University of Wisconsin biochemist and a De Pere, Wisconsin, businessman, have come up with the newest possibility for cigarette filters—Swiss cheese intermixed with charcoal. This combination is said to absorb 90 per cent of the tars, compared to about 60 per cent for paper filters. Point of information: Do any of our readers know who can process 90mm film? If you know, or have even the faintest suspicion, drop us a line at FYI. The address is, of course, PMI, 33 West 60th St., New York 23, N. Y. 90mm anybody?

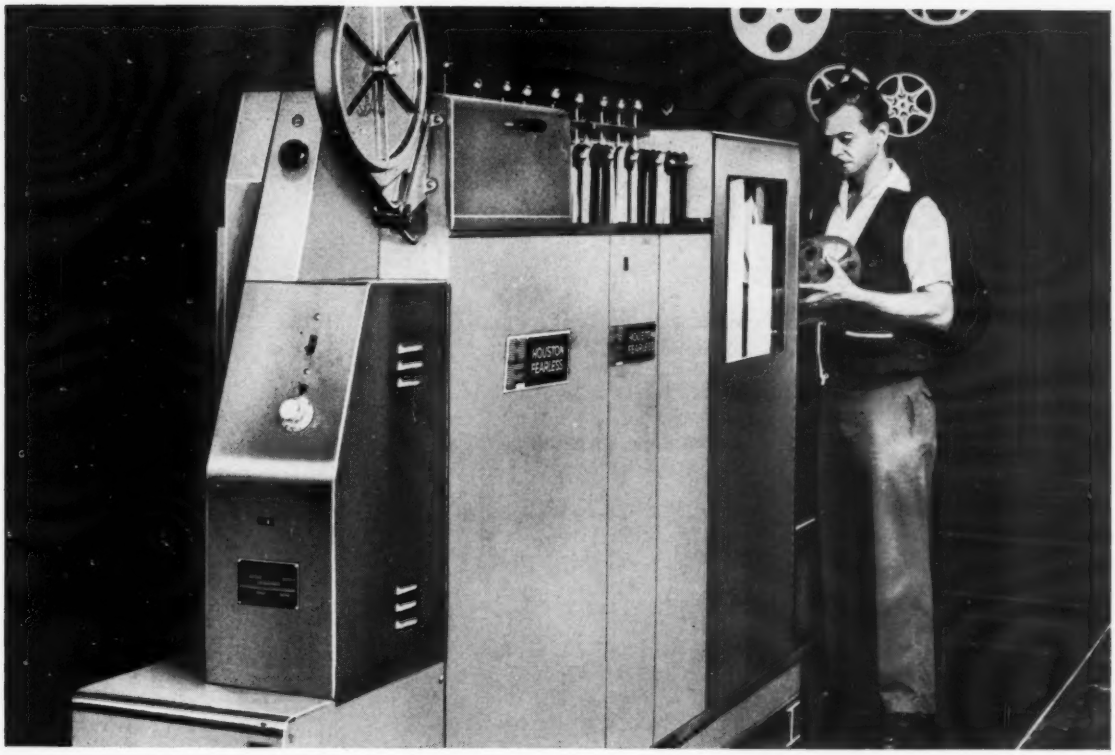
This age of automation

For most, our Readers' Service Cards are a Good Thing. When you see something that looks interesting, just check the reader service number at the bottom, then circle that number on the Readers' Service Card and mail. No fuss, no sweat, no stamps.

Some readers, however, have been returning cards with requests for information about products in a general field; electronic flash, copying equipment, 70mm processors, etc. Then they run into trouble. We use punch cards to fill requests and while the machines (made by people who think for themselves) are marvels, they are high-strung. Anything out of the norm throws them into a tizzy and they refuse to have anything to do with the offender.

If you want general information, write us a letter and we will try to answer you. If you want specific information, circle the number.

Another fault is the card which does not have the sender's name and address. We hate to scold but it really is hard sending information to nobody.—THE END



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Los Angeles County is one of many municipalities to discover the benefits in processing its own microfilm with a Houston Fearless Labmaster*. According to Ray Lee, County Recorder, in-office processing makes filmed documents available for viewing days sooner, while giving his office complete, accurate control over image quality.

Because the microfilm Labmaster is completely automatic, one technician can process the entire day's flow of documents with uniform high quality results. The unit is designed for easy operation in a fully-lighted room. Compact, completely self-contained, it includes an air compressor,* refrigeration system and archival unit for absolute film permanency. Priced to pay for itself from savings in processing costs.

Numerous banks, insurance companies, and other business firms are reaping benefits daily by processing their own microfilm. Send now for details including attractive leasing plan.

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Address _____

City _____ Zone _____ State _____

Get more information. Circle 448, page 91

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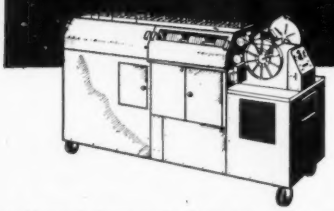

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COMING UP

MARCH 21-25 MPDFA Convention, Keil Auditorium, St. Louis, Mo.

APRIL 1-3 Second Midwest Regional Meeting of Biological Photographic Association. St. Francis Hospital, Milwaukee, Wisc.

APRIL 19-21 National Microfilm Association Convention, Sheraton-Hilton Hotel, New York, N. Y.

MONTHLY MEETINGS

FIRST MONDAY • Rochester Chapter of SPSE. Contact Woodlief Thomas, Jr. Color Technology Division, Building 65, Kodak Park, Rochester 4, N. Y. CO 6-2500, Ext. 3784.

FOURTH MONDAY • Rocky Mountain Industrial Photographers. Contact P. H. Broadie, 2170 S. Lincoln, Denver 10, Colo. Telephone PEarl 3-2200.

LAST MONDAY • Southern California SPSE. Contact Ben Augustine, 235 Annandale Rd., Pasadena 2, Calif. Telephone MU 1-0076.

THIRD TUESDAY • Binghamton Chapter of SPSE. Contact H. G. Morse, Ansco, Binghamton, N. Y. RA 2-4221, Ext. 573. • Industrial Photographers of Southern California. Contact Janet Marshall, Executive Secretary, 5463 Virginia Ave., Los Angeles 29, Calif. HO 5-6614. • Southern California Industrial Photographers. Contact Janet Marshall, 5463 Virginia Ave., Los Angeles 29, Calif. HO 5-6614.

SECOND & FOURTH THURSDAY • Industrial Photographers Association. Contact Tom Holbarton, 181 Lake Drive West, Packanack Lake, Wayne, N. J. OX 4-2058. Or R. Handley, The Port of New York Authority, 111 8th Ave., New York 11, N. Y. AL 5-1000, Ext. 605. • (Second Thursday) National Visual Presentation Association, Inc. Contact M. E. Schack, 19 West 44th Street, New York.

THIRD THURSDAY • Society of Photographic Instrumentation Engineers, New York Chapter. Contact Don Bass, P.O. Box 177 Bethpage, L.I., N.Y. Liggett 4-8196.

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CINEPHONIC 16

...the complete single-system magnetic sound camera: you just grab it and go!

Now — from Fairchild — you can get a single-system sound camera in one handy package. It's really portable—lets you move fast, get close to the action. With the one-man 16mm Cinephonic, one hand guides the camera, the other handles the "sound" and "operate" controls.

Magnetic system assures high-quality recording

Cinephonic uses magnetic recording, which assures quality equal to that of radio and television tape recordings. Recorded sound is not affected during processing by exposure variables, edge fogging, reversal or color processes. Transistor amplifier needs no warm-up, operates with a built-in power supply that takes current from any 117-volt a.c. line. Sound-level meter built into viewfinder shows average level of sound being recorded.

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For complete description and variety of uses, write for new 6-page brochure to Industrial Products Division, Dept. 20, Fairchild Camera and Instrument Corp., 580 Midland Avenue, Yonkers, N. Y.

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FAIRCHILD
CAMERA AND INSTRUMENT CORPORATION

Get more information. Circle 439, page 91

A hundred million potential customers have lured the entire Camera Industry away from the professional market, resulting in an avalanche of amateur cameras and a dearth of versatile, simple precision cameras.

We are especially proud of the new Optika IIa Single Lens Reflex Camera because it offers an intelligent solution to the problems of the industrial photographer.

Superbly designed and constructed, the Optika IIa combines all the features needed in serious photography without the frills of built-in dodads.

Individually mounted lenses of highest correction range from 90mm Wide Angle to 300mm Telephoto. Interchangeable backs permit the use of rollfilm, cut film, film pack, all interchangeable in seconds, on location or in the studio. Negative formats range from 1⅝ x 2¼ to 2¼ x 3¼ and include the new 2⅞ x 2¼ size as well as the 2¼ x 2¼ square format.

A new illustrated brochure is available. No need to burden your secretary with a letter. The word "Optika" and your own name and department on a company letterhead will bring you complete information.

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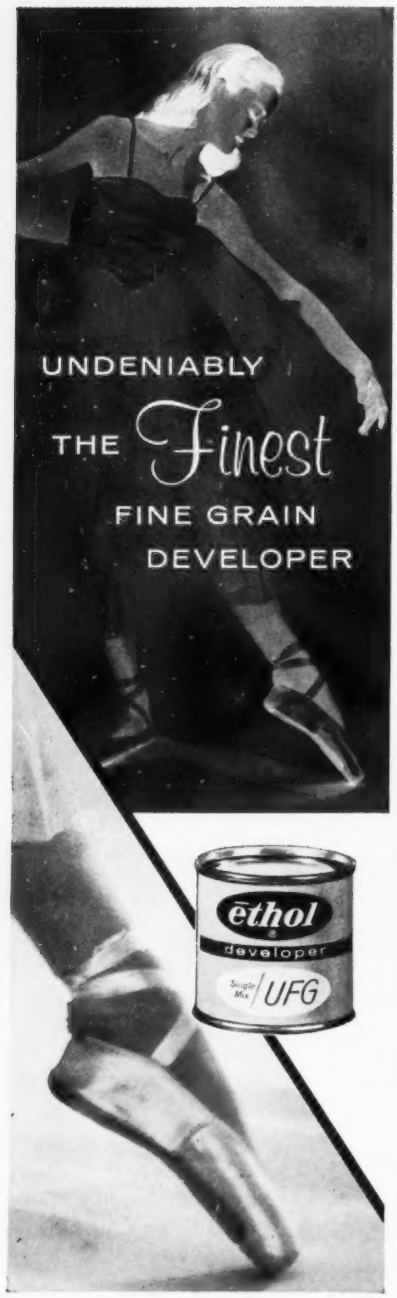
Get more information. Circle 506, page 91



Produces negatives of normal contrast and high resolution. Gives excellent results with all sizes of film. Increases emulsion speed, yet produces negatives of normal contrast. Fast—average developing time, 4 minutes at 70°.

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Get more information. Circle 489, page 91

by David B. Eisendrath, Jr.

WORKING PHOTOGRAPHER

Some comments in incentives, or, the logic of carrying a carrot

A few weeks ago Modernage Photo Service in New York gave their annual profit-sharing bonuses. I was quite interested to see that fifty per cent of the corporation's profit went to their employees. Of course, Modernage is a custom photo-finisher and not a manufacturing concern with a photographic department, yet the principles and purposes behind profit sharing systems have applications to industrial photo departments.

At Modernage, each employee gets "points" for each quarter he has worked for the company and these are multiplied by a factor based on the weekly salary. Bonus points for special activity, suggestions, perfect attendance, and so on are also awarded. At any rate, during the past five years, more than fifty thousand dollars has been given at this small photo-finishing plant. Why do they use a profit-sharing system? Ralph Baum, president of Modernage, says that piecework is never a satisfactory way to operate when you want quality. Wthi a profit-sharing system it's easy to see that every department becomes a team, and with teamwork, the weakest member is always helped by the more experienced.

Obviously this system is not readily applicable to an in-plant photo department, especially one whose profits are only paper, anyway. But the principles of incentive and an opportunity to make increased productivity or higher quality pay off are being used in photo departments with interesting results.

A suggestion with a point

One large plant started a weekly "blind bogie" maintenance program that's attracted a good deal of interest every place I've told about it. At the beginning of each week, or on some regular day, a sealed envelope is placed on the bulletin board. It contains a short sentence and a ten dollar bill. The sentence describes some unusual-but-needed chore to be done; say, "clean the tops of the lockers," "straighten up the equipment locker," "remove dead notices from bulletin board" or any of a hundred innocuous tasks awaiting an eager beaver.

When the department manager notices that the week's little chore has been done, he finds out who did it and the envelope, with the cash and the chore-slip, is his. If no one catches on during the week, the ante is raised the next week. Last fall some beady-eyed hustler won forty bucks for fixing a worn (and dangerous) cord on an electric fan.

The whole thing might sound silly to you, but them's as has tried it have been delighted at the boost in morale the treasure hunt gives and improvement in the appearance of the department has been marked. Several other shops have tried this system using all kinds of gimmicks in the sealed envelope.

Maybe you are not set up so that a petty cash fund will make small bonuses available. Many industrial shops, frowning on the cash payment plan, have substituted time-off or choice of working schedule. One photo department head tells me that his pay-off is in the form of opportunities for overtime assignments.

Credit lines work both ways

Photo-reporters and journalists have long been rewarded by credit lines when their work appears in print, sometimes larger credits being given for exceptional merit. At least three editors I know have used the same stunt in reverse, by being sure to give credit lines on bad pictures which appear in print—especially if the picture could have been improved by a little care and effort on the part of the cameraman.

In the line of incentives toward making better pictures, I've seen some cute schemes here, too. Several plants have a display board where the shooting cameramen display ex-

(*continued on page* 16)

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Here's the Electronic Flash Every Professional Photographer Needs!

Powerful • Compact • One-Piece Unit • Reasonably Priced • Modeling Light Included

NEW SUN-LITE *HI-PRO* MODEL M

Photos by Guy Carrol, Elmhurst, Ill.

The new Model M Hi-Pro provides a tremendous amount of light for large areas . . . has other great features. Operates from camera shutter or as a complete slave, as shown in photo at right. Convenient outlet on each unit eliminates extension cords. Ideal for studio or on location. Gray wrinkle finish. **Self-Contained**

(Accessories Extra) **PRICE COMPLETE $109.95**

STANDARD HI-PRO Same as Model M, but less modeling light (20-second recycling) **$89.95**

FAST RECYCLE TIME—8 seconds at full power, 5 seconds at half power.
SYNCHRONIZATION—"X" or "O" delay only.
FLASH DURATION—Full power 1/500 second, half power 1/900 second.
ANGLE OF COVERAGE—60 degrees.
HIGH POWER RATING—Full power 150 Watt-Seconds, half power 75 Watt-Seconds.
BEAM CANDLE POWER SECOND RATING—4000.
EFFECTIVE CANDLE POWER SECOND RATING—3950.
COLOR TEMPERATURE—6000 Degrees Kelvin.
SLAVE OPERATION, PHOTO TRIPPED—No. 5653 photo tube, can be rotated 350 degrees.
SHUTTER TRIPPED through thyratron tube to prevent burning shutter contacts.
READY LIGHT—Bright neon bulb ON when fully charged.
MODELING LIGHT—50-Watt with ON-OFF switch. Covers exact flash pattern.
FLASH TUBE—Exclusive Sun-Lite design on tube and reflector.

MODEL M

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5½" high 6" wide 6½" deep	Only 4½ lbs.	A.C. operated only 110 volts, 60 cycle Single phase Power consumption 60 Watts.	Base tapped for ⅜"-16 or ¼"-20 stud. Rubber feet for surface mount.

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HIGH OUTPUT: you get more light with conservatively rated Guide Numbers of 56 with Kodachrome, 220 for black-and-white, 100 watt-second of uniform illumination!

LIFETIME NICKEL-CADMIUM BATTERIES: rechargeable, eliminates additional flash cost!

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VARIABLE BEAM REFLECTOR: 50° for normal shooting, or full 80° for wide-angle!

VARIABLE POWER: has selector switch on flash head gives either half or full power!

ECONOMICAL AC OPERATION!

HIGH SPEED FLASH: 1/1300 sec. at full power, 1/2500 sec. at half power!

SHORT RE-CYCLING TIME: super-fast, only 9 seconds on battery!

Photo cell slave unit and side-light extension accessories also available!

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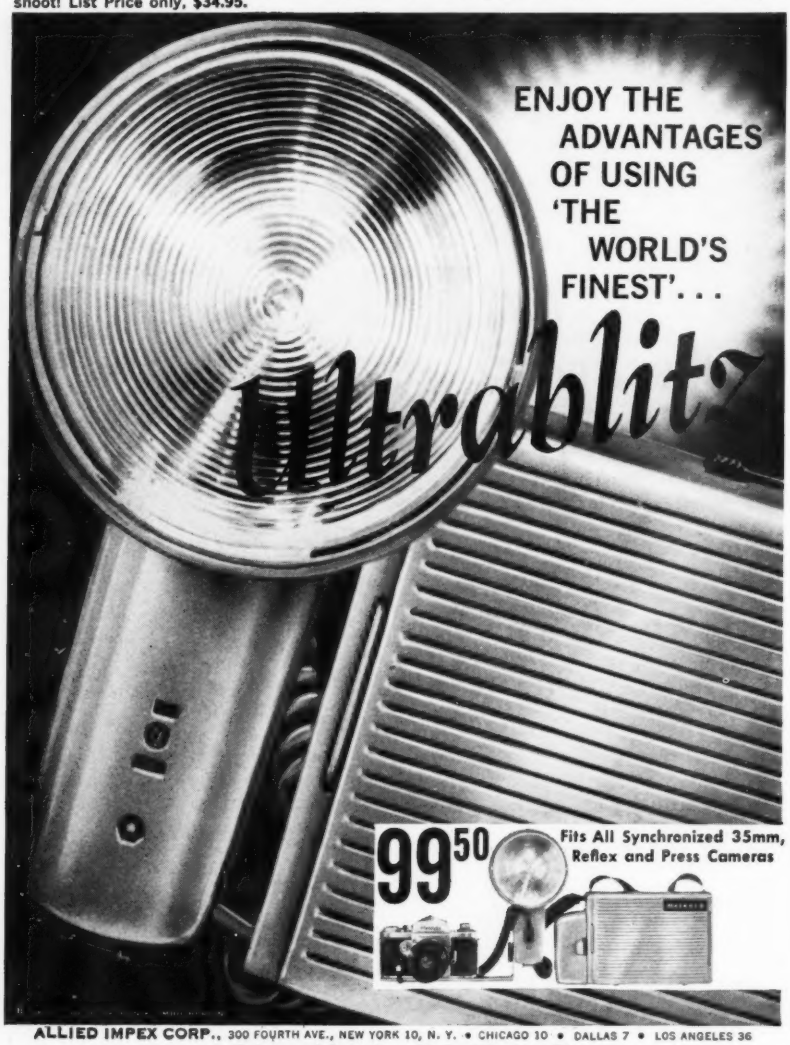
And Now... Double the Amount of Flashes with the Exclusive Meteor II LIFETIME 'BATTERY BOOSTER'... Contains rechargeable Nickel-Cadmium Batteries! You're never without power with your Meteor II. On extended location assignments, just plug your Booster in . . . You're ready to shoot! List Price only, **$34.95.**



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Get more information. Circle 452, page 91

(*continued from page* 14)

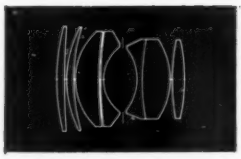
amples of their best work. They have little legends under each man's best picture with the date when it was made. Pretty soon someone notices how long ago this one or that one was made, and there is an added stimulus to put up something more recent. To say, "Haven't you shot anything good *recently*?" or "anything that *you* consider good" is often incentive enough. And if someone has a rapidly changing display of top notch shots, he may be entitled to a one-man show.

Purchase system for supplies

An amusing practice put into effect in newspapers and certainly applicable to industrial plants is the system introduced to cut down on waste materials. As one photo department manager told me, "We don't mind the photographer making an occasional extra print for a subject who has gone all out in cooperating, and we don't mind the photographer who wants to make some exhibit prints now and then, but the boys who are sneaking a wedding business on the side, or are making half a dozen prints where only one is needed are breaking our budget." So they put the photographers on a purchase system, where film, bulbs and paper are charged out to them (either actual cash or a credit system) and as assignments are completed, they are "bought," job by job. Not only does this really effect good savings, but one newspaper actually does this with a cash disbursement and at the end of each month, the photographers end up making more than they ever did before—and the departmental budget still shows a big profit over what it has been.

Top photo man at a large auto company told me that he had used a unique incentive system to get more effort put into the very routine assignment that is normally dull, uninteresting, but has to be covered just the same. He offered two hours off early to anyone for each picture of a "dog" assignment published in the national press. An eager young lensman promptly covered a safety award presentation and talked the recipient of the award into posing with the president of the company showing him his safety idea. By the time they got the president of the company in a hard hat and safety goggles with an interesting background, the picture made the wire services, was published in three dozen papers and the photog ended up with a week-off!—THE END

now the f1.4 Nikkor with automatic diaphragm for the Nikon F automatic reflex



The new Nikon F with its fully automatic features is reason enough for any photographer to consider 35mm photography with this reflex. The availability of the new Auto-Nikkor f/1.4 with automatic diaphragm makes it even more compelling. And here's why:

The f/1.4 Nikkor gained acceptance among users of 35mm rangefinder cameras because of its combined quality and speed: its almost incredible resolution—even at large apertures; its sparkling, fringe-free color rendition; and its almost uncanny ability to produce pictures under the most impossible light conditions.

On the Nikon F automatic reflex, the new f/1.4 Auto-Nikkor assumes an even greater significance, beyond even its amazing definition and its recognized desirability for available light photography. For while it does bring to the Nikon F its unique qualities of speed and resolution, it also makes the Nikon F finder the brightest of any reflex—almost as bright as the image appears to the naked eye.

Get more information. Circle 485, page 91

The visual effect is positively startling. The lens virtually 'snaps' in and out of focus. There's an entirely new comfort and assurance in handling the camera. And you find that you work with greater ease and speed than you ever imagined possible with a reflex.

The new Auto-Nikkor f/1.4 is fully automatic. The diaphragm is always wide open for focusing and viewing. At the instant of exposure, it automatically stops down to 'taking' aperture—and then, instantly reopens to f/1.4 in readiness for the next picture.

The new Nikon F is setting the pace for progress in 35mm photography. It is providing the creative photographer with equipment and accessories that will open up new avenues for him to explore and gain for him a new freedom of expression – Coupled Exposure Meter, Electric Motor Drive, an incomparable array of Nikkor lenses, special copy and close-up equipment, and now . . . the new Auto-Nikkor f/1.4. This is only the beginning.

NIKON F with 58mm AUTO-NIKKOR f/1.4 . . . . . $375.00
NIKON F with 50mm AUTO-NIKKOR f/2 . . . . . 329.50

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Kodak
INDUSTRIAL
ROUND-UP

Ask the impossible

Some troubles still may take a little longer to solve than others, but in almost every photographic area, the word impossible is becoming obsolete.

Why impossibles are becoming impossible—to begin with . . .

There's a professional film behind it all. A film that sees more realistic scale in the New York skyline, for example, not leaving out the snap of highlight nor the strength of shadow, and revealing fine detail in both.

A film that has practically everything.

- *for speed* . . . 200 is about right
- *for definition* . . . a 16 x 20 from a 2¼"-square negative is crisp, sharp and clean; fine professional detail
- *for exposure latitude* . . . no compressed contrast here
- *for modeling* . . . depth is one of the dimensions of this perspicacious emulsion; and it includes your kind of healthy respect for flesh rendition.

The film: Kodak Plus-X Pan Professional—a roll film that ennobles the product of the mobile camera, 120 size, 620 size, and 35mm.

Talk of sharpness, for most films, usually includes—in the same breath—talk of grain size.

In this, Plus-X becomes the exception, even in oversize enlargements.

Needles and thread, blades of grass, shavings from a metal lathe—all show their slivery profiles, and grain never offers objectionable interference.

Chalk it up to new emulsion technology; then, go on making improbable 16 x 20's as though you'd never heard of the impossibilities.

The improbable second chance. Indeed, with Plus-X the second chance at getting the perfect negative becomes unnecessary—the second chance that is usually impossible to come by anyway!

Newer than its 35mm size are the Plus-X professional sizes 120 and 620. These you purchase 25 rolls to the package. Each roll inside being individually sealed in foil for less bulk in pocket or bag, less litter, quick reloading. And each roll is frame-numbered to simplify negative identification.

Some impossibles are only on paper

Take a setup like in the picture top left on the next page, for instance:

Close quarters, immovable objects, foreground as important as background, models amid clutter, harsh window glare, no time (hurry it up, you're holding up high-priced production).

It's like the world is plotting your downfall.

But *hurry it up* means now (not tonight) is the time to take the picture, so you've got to. You wind up with the contrast mishmash you expected. (You can imagine how the negative looks.)

An impossible thing to contend with yesterday, but today a good picture can come out of it all—if you have the right paper.

Like the top right-hand picture! Same negative, different paper.

For the harsh picture a good, grade-2 contrast paper was used, with normal printing. For the better picture, Kodak Polycontrast Paper was used, along with a small portion of professional wizardry. The wizardry is selective contrast printing, really not magic anymore. But it is the only way that *this* negative and ones like it could possibly be turned into okayable prints. And with Polycontrast, it's fairly easy to do.

Here's the recipe used on the right-hand print

One sheet of Kodak Polycontrast Paper. Plus one set of Kodak Polycontrast Filters. Plus some Kodak Dektol Developer

diluted 1:2. Plus dodging paper.

Then we go to work.

The contrast problem lies mainly in the top and bottom thirds of the negative. The middle third is close to normal.

So, if we were to dodge out the top and bottom thirds completely while printing the middle third alone, we should get a normal-looking middle third. (Use Kodak Polycontrast Paper without using a filter, and you get an on-the-nose, normal print, as though you had used a grade-2 paper.)

That's how we handled the middle third.

On the other hand, the bottom third of the negative is flat. It requires grade-4 contrast control to beef it up to normal.

So, with the same sheet of "Poly" on our easel, but with a No. 4 Polycontrast Filter on our enlarger, and a black paper mask over the upper two-thirds of paper, we continue to print.

Now for the top third. It is harsh and glary, requires a No. 1 contrast grade to bring it back to normal. So we repeat the process of masking and exposing, only this time using a No. 1 Polycontrast Filter on the enlarger. This should soften the glare, kill the harshness, and bring out detail around the models.

A minute or so in Kodak Dektol Developer and all we've hoped for—the impossible—appears. Three simple exposures, two filter changes, and a yen to make miracles made it possible.

Complicated? Sort of, but this was an unusual one, and "complicated" is better than a "sorry, couldn't do it!"

You don't need a mishmash to do the impossible with Polycontrast

Take house organs, for example.

The printed page will look better, and read better, when picture tones match up from one picture to the next.

With Kodak Polycontrast Paper it becomes a simple matter for you to relate tone and contrast from one picture to the next easily, even though negatives may fall to the right or left of desirable.

You need only one box of "Poly" and a set of Kodak Polycontrast Filters. There are seven filters. One each for familiar contrast grades 1, 2, 3, and 4. The three others are for *in-between* contrast refinement. These are numbered 1½, 2½, and 3½.

(Remember, with a normal negative, you don't need to use filters. Print "Poly" *straight* and the paper will act handsomely—like a grade-2 paper.)

Another "impossible"

solved by Kodak Polycontrast Paper is in the area of *mismatched* portfolio prints. Print them on Polycontrast and they'll match.

In a nutshell

There are now three "Poly" papers: Kodak Polycontrast, Kodak Polycontrast Rapid, and Kodak PolyLure.

In kind, these papers are one. In speed and image color they differ.

Polycontrast has speed and warm-black tone like Kodak Medalist Paper. Polycontrast Rapid is colder, but still warm-black, a tone and speed like Kodabromide Paper. PolyLure has a speed and rich, warm-brown tone like Kodak Ektalure.

And with that, likenesses end. Inspiration begins.

For "Poly's" range between highlight and black is long. Its contrast relationships are definite. And of detail, in these papers you'll see plenty. For "Poly" chemistry is different, you see. *A high d-Max built in . . . a capacity to produce rich, deep blacks.*

There's another wonderful characteristic, too. A capacity to retain shadow details that can especially delight the photographic heart.

Image tone is uniform throughout the entire "Poly" contrast range.

Contact printing is possible. Simply reduce illumination on your printer, and use Kodak Polycontrast Acetate Filters, 11 x 14.

With Kodak Polycontrast Papers you need only one box on hand. Yet, you never run out of a given contrast grade. No seldom-used paper grades to go stale on your shelf. No leftovers. One box, a few filters . . . that's all. You're ready to do all possible (plus some *impossible*) with any worthwhile negative that comes along.

Soul mates

If Plus-X is a film to rave about, and if Polycontrast papers provide control no less than extraordinary, it would seem appropriate to point out the possibilities of using the pair as a matched set.

Someplace above is mention of Polycontrast's high *d-max;* its capacity to produce rich, deep blacks and to retain shadow details like crazy.

Such paper sounds like the perfect way to serve your public the full potential of a Plus-X nurtured picture.

A try, at least, may lead to a discovery.

The last word

Everywhere we write something, we tuck in a line that reads: *Kodak products are made together to work together.* Plus-X and Polycontrast are made under the same scrutiny under the same roof. Also under that roof are the go-together chemicals that bring out the best in these emulsions.

One of these chemicals is the workhorse developer, Kodak D-76.

Though we've tried many, we've yet to discover the one developer that is priced lower, or that will process more film, or that will produce better quality any quicker in Plus-X negatives than D-76.

Dilute 1:1. See beauty in about eight minutes.

As we say: made together to work together. Should we add, *without compromise?*

Please write if you would like literature or if you have questions on specific Kodak products we've talked about here.

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Get more information. Circle 417, page 91

by Arnold Eagle

INDUSTRIAL MOTION PICTURES

Cold weather is no good and heat doesn't help film making either

Let's face it: film making was really designed for the well-controlled temperatures indoors. The minute a cameraman steps foot outside—unless it is a balmy spring day—he runs into temperature troubles. When working under extreme cold or heat, his life is sheer misery.

Most people are aware that oil and grease congeal in below zero climates and that film exposed to tropic heat over long periods of time will deteriorate.

But even a moderate drop in temperature can slow a camera down to such a degree that the shot is useless. Batteries can become inadequate for running the motor. Metals will contract; where gears are made to close tolerances, this may prevent gears from meshing.

The worst cold weather problem is the condensation of moisture in the camera, on the lens and on the film. This condensation is caused by bringing the camera from a cold place to a warm place.

Different makes of cameras behave differently in low temperatures. Even individual models of the same camera exhibit different reactions.

If you plan to use a camera in low temperatures, have it winterized by replacing all regular lubricants with special "non-freezing" types. Test your equipment in a refrigerated "cold" room where the temperature can be lowered to the level expected on the job. Check the cold weather performance of your equipment with the manufacturer.

Some expert weathermen

For example, if you call Chuck Austin of Mitchell Camera in New York, he will tell you that the NC or BNC Mitchells are hopeless in cold weather and should not be used at 45°F or colder. On the other hand, the 35 Standard Mitchell can be made trouble-free even at 40°F below zero.

Mitchell has a special heating element that can be built into the camera. It can keep the camera running in any temperature. They also make a heated barney for the whole camera, but unless you maintain a constant temperature, you may face condensation on the film because of the sudden temperature change within the film magazine.

A line of heated camera barneys was recently introduced by Birns and Sawyer. Seven layers of sound-absorbing, heating-retaining insulation are said to provide a minimum heat loss in temperatures as low as 60°F below zero. These barneys are provided with a three-way control switch, adjustable to low, medium and high current draw, depending on temperature and wind. Models are made for Kodak Cine Special, Hulcher, Bell & Howell, Arriflex, Fairchild, Photosonics, Auricon and Fastax cameras.

A gyro tripod will not work in cold weather because of the flywheel and complicated gears. Most of the fluid head tripods freeze at low temperatures. One exception is the Camera Equipment fluid head that works even in below zero temperatures.

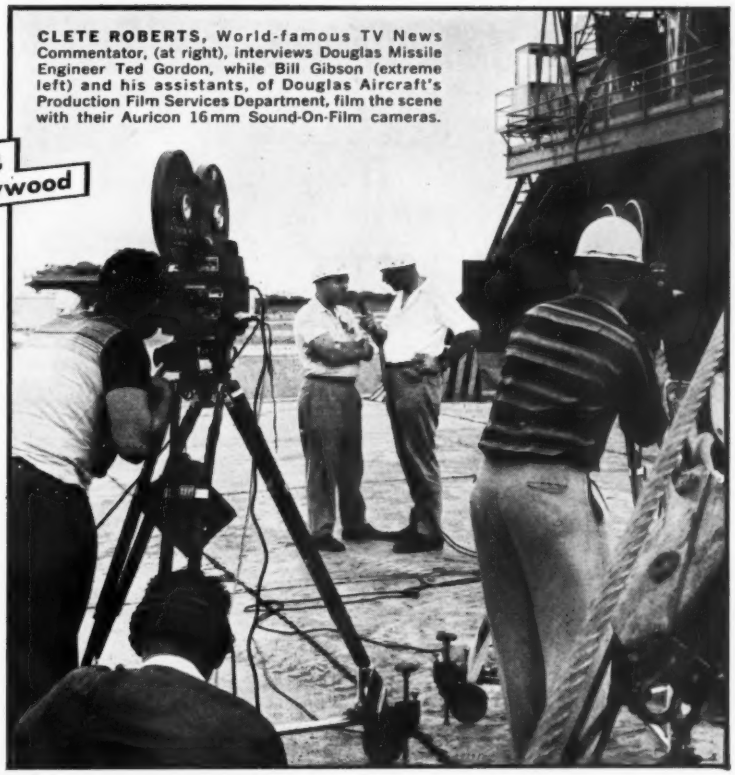
Dry cells or wet plate batteries lose their power at low temperatures. They can be kept warm by covering with insulating materials. Their power should be increased by adding extra cells hooked up in parallel so as to increase the amperage without increasing the voltage.

Film maker Willard Van Dyke just returned from Alaska where he made a film for General Electric. He found that the new nickel cadmium batteries were the only ones not affected by cold weather. He was able to lick the condensation problem by never bringing camera and film directly into a warm room from the cold air. He first put the camera in an unheated room where the temperature never went above 30 F. This room was used for loading and unloading film magazines, and sealing the exposed film into cans with

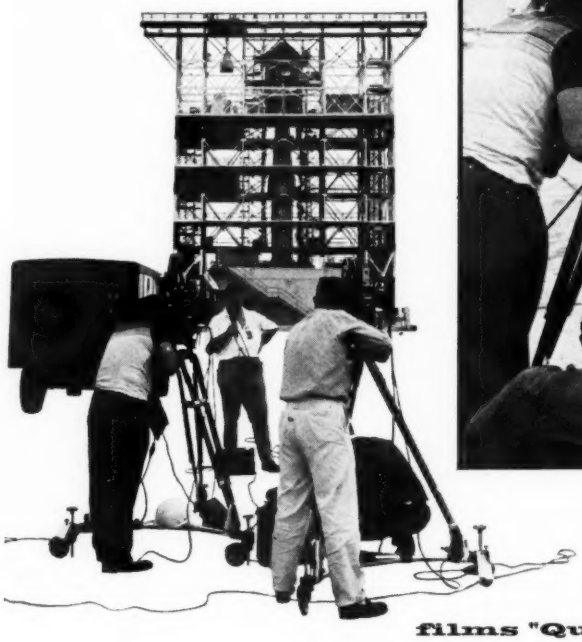
(*continued on page* 22)

DOUGLAS

Auricon Hollywood



CLETE ROBERTS, World-famous TV News Commentator, (at right), interviews Douglas Missile Engineer Ted Gordon, while Bill Gibson (extreme left) and his assistants, of Douglas Aircraft's Production Film Services Department, film the scene with their Auricon 16mm Sound-On-Film cameras.



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- ★ Optional Optical or Filmagnetic Sound-On-Film.
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During the critical count-down and through the thunderous and fiery launchings of the Air Force Thor Missile at Cape Canaveral, every detail of these space technology achievements is faithfully recorded with sound and color film. Auricon 16mm Cameras, operate by remote control within 200 feet of the searing blast of the rocket engines!

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Get more information. Circle 409, page 91

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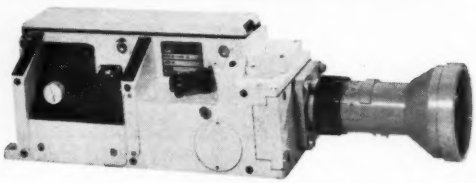

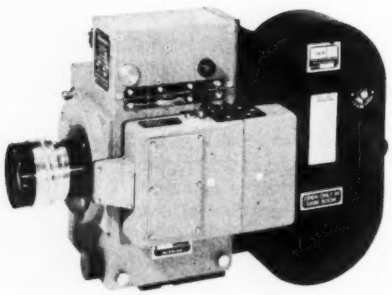

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Get more information. Circle 507, page 91

IND. MOTION PICTURES

(*continued from page* 20)

plastic or cloth water-proof tape.

Plastic electric tape is good for this purpose except that it becomes brittle in extreme cold and should be kept in a warm place until you are ready to use it. After it is on the can, it will stay put. To be doubly sure, cover the plastic tape with regular camera tape.

Camera expert Dom Notto of Florman & Babb spent three winters in the Arctic as an Air Force camera repairman. He suggests that when you use regular camera tape, be sure to cover it with wax to make it waterproof. He also warns that all electric wires and battery cables should be of pure rubber since plastic will snap in extreme cold.

Edward Brown, in charge of N. Y. Camera Equipment's repair shop has outfitted many successful Arctic film expeditions. He says that the most efficient camera for real cold weather shooting is the 16mm or 35mm Arriflex. He puts the French Eclair Camerette in the same class. As you may know, this camera is convertible; it can be used for either 16mm or 35mm.

Brown suggests that you use 200-ft. magazines in the Arriflex as 400-ft. magazines require too much power to run well in cold weather.

Another camera for which he has a high regard is the spring-wound Bell & Howell Filmo (16mm) or Eyemo (35mm). Of course, it must be completely winterized, with all standard lubricants replaced by "cold weather" oils. Brown suggests that batteries be placed in an insulated box with some chemical handwarmers. These handwarmers can be a real lifesaver to any cameraman who must shoot in very cold weather and finds his camera slowing down at temperatures around 40°. One or two handwarmers, which can be purchased at sporting goods stores, can put new life into a cold battery.

Cover cold camera

An unheated camera barney is quite a help as it keeps the cold wind from the camera. When it gets very cold, the cameraman is in danger of a skin burn if his bare skin should touch the cold metal of the camera. To avoid this, cover the eyepiece and viewfinder with cloth.

Some operations, such as threading film, cannot be done with gloved hands. To avoid frostbitten fingers, use thin cotton or silk gloves which are fine enough to let the cameraman load even the most complicated

(*continued on page* 86)

.....A NEW UNICORN PRODUCT.....

Solvent Film Cleaner

CLEANS your film and tape

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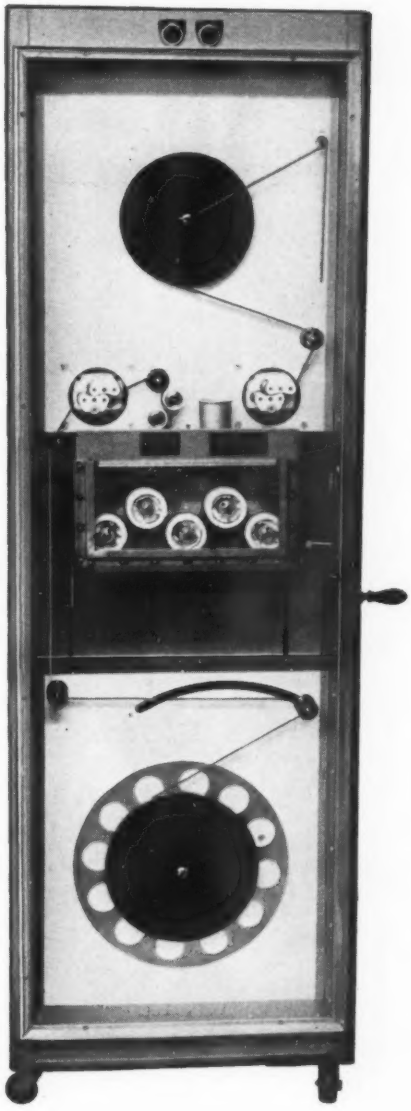

All you have to do is put the film in place and fill the solvent tank. The new Unicorn cleaner does the rest automatically—and speedily with all scrubbing action taking place below the solvent level. It effectively cleans motion picture films (negative and positive) and magnetic tape at rates to 300 feet per minute with complete safety. Cleaning is accomplished by counter-rotating velvet covered scrubbing rollers, effectively removing dirt, lint, oil, fingerprints and wax.

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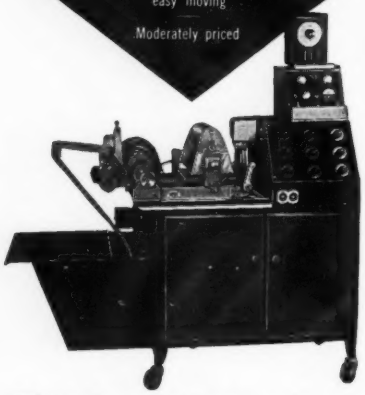

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Get more information. Circle 401, page 91

by Samuel Lang & Leonard Zoref

INDUSTRIAL COLOR

A tool for every job: the equipment for color print processing

In this space last month we sketched an outline of the equipment necessary and desirable for *exposing* the Ektacolor print. Now we take up the equipment for *processing* the exposed print material. We will again move from the simple to the complex: that is, from the economy to the deluxe.

It is appropriate to say that color print processing does not require the skill that exposing the print does. While a good deal of personal judgment is required to select the proper exposure and color balance for each negative, the development of the prints should follow strict routine. What processing demands of the photographer is accuracy and extreme care rather than a good "feel" for color.

In terms of equipment, the simplest method of color print development is tray processing. Any good photographic trays are suitable and if the photographer is willing to replace solutions into bottles between steps, he can get along with two or three trays. The occasional user is probably best off with the tray method. And with the Ektacolor paper chemicals, he will be pleased to find that most all, with the exception of the developer, can be used a number of times if properly stored in stoppered bottles. The use of fresh developer each time will undoubtedly give the occasional user better and more consistent results.

If the photographer's hands are to be in prolonged contact with Ektacolor solutions, as is likely to be the case with tray processing, he should, by all means, wear rubber gloves. Most color developers are very irritating to the skin and Ektacolor developer is no exception. Besides rubber gloves, a good preventive is to apply a product called Kerodex No. 71 (made by Ayerst Labs, New York City) to the hands before going into the darkroom. It is a protection against irritation and developer stain as well. Should the photographer get developer on his hands by accident, he would be well-advised to wash the hands in a neutral soap such as Phisoderm or Phisohex.

If Ektacolor prints are going to be made regularly, it is best to set up tanks to handle the processing. Standard 3½ gal. hard rubber tanks are ideal for 8 x 10 prints. The advantage of hard rubber over stainless steel is that once the solutions in them are brought up to proper temperature, they will maintain it for a longer time.

If your budget permits, an ideal set-up is a completely self-contained processing unit such as the Calumet, Leedal, Arkay, Rolor, etc. Most of these units are shipped completely set up for nitrogen burst agitation and automatic temperature control. They are usually of heavy gauge 316 stainless steel and should be heli-arc welded.

The bleach tank should be made of red brass but several manufacturers line a stainless steel tank with plastic which is adequate.

Processing baskets are made of stainless steel with Saran screening for the compartments, which separate the prints one from another.

Unit processing equipment is available at a wide range of prices, from $1000 for a 3½ gal. economy unit to a $15,000 automatic control unit for 16 x 20.

Experience has shown that extreme accuracy in Ektacolor processing is most essential. There is no doubt that more remakes are caused by improper processing than by exposure errors. It is far more economical to have a highly-efficient, well-trained, well-paid technician doing the processing instead of someone who will not bring to the job the care and skill it requires.

Nitrogen agitation has eliminated most of the inconsistencies which occur with hand agitation. However, unless the gas distributors are abso-

(*continued on page 26*)

NEW!

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Get more information. Circle 449, page 91

Something new has been added to the Model EP-1000 Photographic Color Analyzer . . .

Extra Plug-in Attenuators. Not just one extra set but *four* in a single accessory. With it you can set up your instrument for six different types of color negative criteria. . . . Print negative after negative without reindexing.

HOW DOES THE EP-1000 WORK?

When you have made a satisfactory print from an average color negative, you can thereafter use this average negative as a standard to control all other negatives of this type. The standard instrument has two sets of attenuators. With these you can index your instrument to analyze two different types of color negatives. In the event that you wish to retain the information indexed into the instrument, and also to index to other negative types you have only to plug in your EA-40 accessory attenuators.

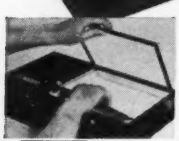
Having tied your exposure variables to a reproducible electronic reading you have eliminated the guess work in color analysis, made the first print electronically.

For the name of a dealer in your area who stocks and will demonstrate the EP-1000, and information on the external attenuator accessory EA-40, please address inquiries to Macbeth Instrument Corporation at the address shown below. We will do the rest.

MACBETH INSTRUMENT CORPORATION
P.O. BOX 950 NEWBURGH, N. Y.

Get more information. Circle 467, page 91

Interchangeable click-stop masks make one 8 x 10, two 5 x 7, four 4 x 5, four 3½ x 5 or eight 2½ x 3½ (wallet sized) prints.



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Ektacolor outfit with regular masks $67.50
Ektacolor outfit with focusing masks $97.50
Special size masks quoted on request.

Get more information. Circle 497, page 91

INDUSTRIAL COLOR

(*continued from page 24*)

lutely level, you will get improper bursts which will cause uneven development. (Until recently, by the way, recommended pressure was 15 lb./sq. in., but this has been found to be inaccurate. For better results, adjust the pressure regulator so that the solution rises ⅝ of an inch before the bubbles reach the top of the solution.) A gas burst cycling time with provision for "differential" or "bleed" pressure control will overcome variations in agitation which can occur if solutions back up into the distributor during the interval between bursts. Keeping the line under constant pressure will prevent this. One adjusts the valve to a point where further adjustment will result in bubbles forming.

Linde Division of Union Carbide is now offering their Oxweld M-40 manifold control assembly for use with their high-pressure LC-3 cylinders. Two or more nitrogen cylinders are attached to the unit with one serving as the primary feeder and one as the secondary feeder. The automatic changeover cuts in to supply nitrogen when the primary feeder is used up.

Retouching methods

Unfortunately, Ektacolor emulsions are soft and subject to abrasions. Most laboratories use diffusion enlargers which minimize the amount of spotting and retouching necessary. However, some work still remains to be done. Several dyes are available which will work quite well with Ektacolor paper, including Kodak Dye Transfer dyes, Kodak Flexichrome colors, Webster Dyes, Dr. Martin's Dyes and a newcomer called Ektacolor Retouching Colors. The last are made by Retouching Method Company, Chatham, N. J.

Kodak recommends a new method of area correction which simplifies the technique considerably. Cut a ½-in. section from a cake of Flexichrome colors and wrap most of it in aluminum foil to form a chalk stick. Apply the color thoroughly to the area to be corrected. Smooth out the color with a clean tuft of dry cotton. Rubbing with dry clean cotton will lighten areas. Additional color can be applied directly to the area and blended. Surrounding areas and highlights can be cleaned with cotton dampened with anhydrous denatured alcohol. Up to this point, all color can be removed. To make the retouching permanent, subject the area to steam for a few minutes.—THE END

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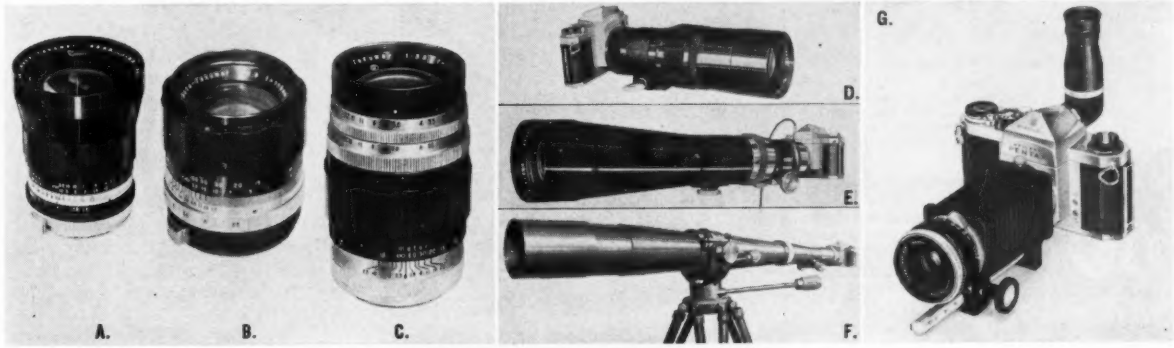

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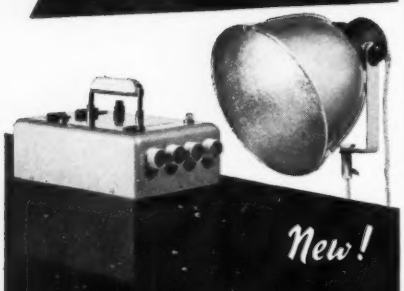

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Get more information. Circle 402, page 91

by Edward R. Farber

ELECTRONIC FLASH

Wisconsin pressmen spark Farber to cast light on E.F. questions

The following consists of answers and afterthoughts stimulated by questioners at a recent Wisconsin State Press Photographers Convention in Madison. Perhaps among them there's a solution to a problem that has been puzzling you.

Q. How can I cut ghost images when shooting sports where the existing light levels are high?

A. With the brilliant light level in sports arenas these days this problem is becoming more acute, particularly with miniature cameras sync'd for speedflash only at 1/30 sec. or thereabouts. I doubt that ghosting can be eliminated, but here are some tips for reducing these secondary, blurred images. If the existing light is of the incandescent type, use a red filter with pan film, or use orthochromatic film. This will cut down the effect of the reddish tungsten light relative to the effect of the bluish speedlight.

You can also increase the intensity of your speedlight and use a smaller lens stop. This is probably best accomplished by adding more flash units or extensions rather than by pouring more juice through one flashtube. The reason for this is that the duration of the flash increases, and action-stopping decreases, as more power is added to a flashtube.

Fast films and high light levels = ghosts

Even then it takes a lot of stopping down to eliminate ghosting entirely. The shot below, made with Agfa Record film, demonstrates ghosting at f/16. A total of 4000 watt-seconds was concentrated on half the gym, with a 200-watt-second unit for triggering and fill. The shutter was open for about 2 sec.

All else failing, I can only suggest that you place a 1/400-sec. sync'd front shutter mounted in a filter holder over your lens, and keep the focal plane shutter open.

Q. I've had trouble with my electronic flash unit ever since I replaced a broken trigger tube. What do you suggest?

A. This is not an unusual problem. The best way to avoid it is to buy a tested trigger tube from the manufacturer of your speedlight. Trigger tubes are frequently pre-selected for certain characteristics important in the specialized electronic flash circuit. Although a run-of-production tube lives up to the tube manufacturer's specifications, it may not deliver certain performance characteristics needed by your unit.

Q. After repeated flashing, the flash head of my unit heats up in one spot. What goes?

A. More often than not, this localized heating in the flash head (or the power pack) is caused by the charging resistor, which is in series with the battery or rectifier and the capacitor. This charging resistor dissipates as much heat as the flashtube itself, and the heat-up is a normal effect.

Q. I had a heck of a time when I tried to connect four units in series for simultaneous tripping. Could you go into this?

A. If your units are identical and you connected them in parallel, perhaps you did not observe polarity—that is to make sure that all ground or negative leads terminate in one wire, and that all positive leads terminate in

(*continued on page* 30)

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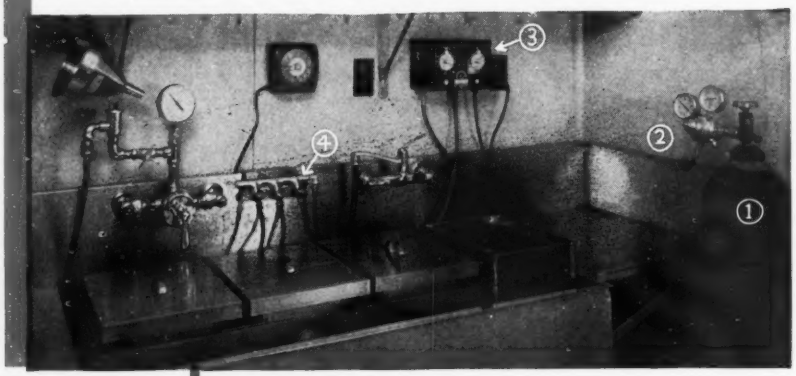

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ELECTRONIC FLASH

(*continued from page* 28)

the other wire. Now, if you have units which do not use trigger tubes, there is an additional precaution. See if there is an excessive arcing at the sync contacts when three or four units are combined. Check this by shorting across the combined trip leads. If a noticeable spark occurs, do not use the combined units frequently or the shutter contacts may become pitted and burned. By the way, pitted contacts may function with electronic flash, yet cause late firing or misfiring when used with chemical flashbulbs.

Q. Do you have any suggestions for the use of electronic flash in extreme close-ups?

A. I've heard of a variety of problems in connection with this topic. Some photographers claim that they always get overexposures, some say that they invariably get underexposed results. Some say that guide numbers do not work. It can be that a reflector which provides even enough illumination at normal working distances has a hot spot or a dead spot very close up and that this is causing difficulty. Aside from this possibility (which can easily be detected by shooting a plain, plane surface at your working distance) guide numbers *do* work. What may be throwing a monkey wrench into the works is the failure to account for bellows extension. The following formula feeds this factor into the calculations:

$$\text{f-number} = a \times b \times 12 \div (c \times d)$$

In the formula, a is the guide number; b is the focal length of your lens (in inches); c is the lens-to-film distance (in inches) and d is the light-to-subject distance (in inches). Twelve is inserted to convert the guide number for use with inch units.

Literature for your file

Amglo Corp. (4325 N. Ravenswood Ave., Chicago 13, Ill.) has a Flashtube Bulletin showing a great variety of specialized tubes and lists some trigger coils as well. Kemlite Laboratories (1819 W. Grand Ave., Chicago 22, Ill.) Flashtube Bulletin lists tubes, and gives several circuits for firing flashtubes. Sylvania Electric Products (1740 Broadway, New York 19, N.Y.) has two new bulletins listing a surprising number of Strobotrons and Glow Modulator Tubes which are specialized light sources for photographic, facsimile and stroboscopic uses. Might be useful to know they exist.—THE END

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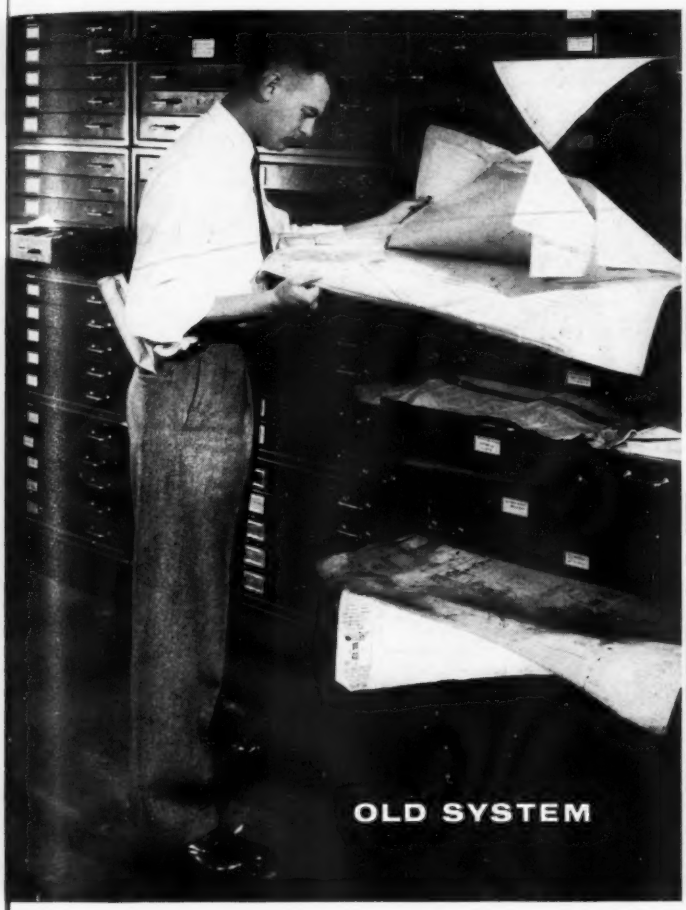

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AN EDITORIAL

THINGS ARE GROWING SMALLER

We have respect for the question, "What's in it for me?" It is hardboiled, but sincere, and it awaits an answer. And we hope that as you peruse the stories on microfilm on the pages that follow you apply this cynically selfish question. If you are cynic enough to get at the truth and selfish enough to apply your answer, chances are that you will become a student of microreproduction yourself, unless you already are one. ● We'll give you three good reasons why. ● First, microreproduction is almost purely functional as opposed to, say, view camera work. This fact may be as attractive to many of the 75,000 or so professional photographers in the United States as a hot breeze from a stockyard. However, because microfilm is a tool, and a sophisticated tool at that, it almost demands a professional to administer it. Furthermore, its usefulness is greatest in the organization, industrial, educational, governmental. As a reader of PMI, this should mean you. ● Second, in the application of this tool, the two most important factors are systems and science. The science involved is photographic science, something which every photographer and reproduction man must have at least a nodding acquaintance with. ● Third, microfilm's use has grown in the past, is growing rapidly now, and shows every indication of sustaining and increasing this growth in the future. Let us cite an example from a field in which microreproduction is fast enlarging its foothold—engineering drawing reproduction. In a public address a Department of Defense spokesman said, "Within the next three years in the DOD, it is my personal observation that 80 to 90 per cent of new engineering data will operate from a microfilm base." Until and unless something more efficient than microfilm comes along one might guess that this prediction will come true for industry as well.

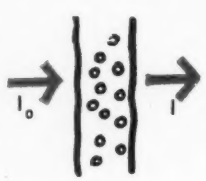
The Editors

DENSITY

All industrial photographers have some concept about the meaning of density. They know it refers to the light-stopping power of a photographic deposit and that it can be measured on a densitometer, but often that is as far as the understanding goes. Actually, the meaning of density in its many ramifications is a rather complex subject. The first step toward a better understanding of this apparently simple subject is to review its origin. (Color density is not considered here.)—by Lloyd E. Varden

The principles of how light is progressively reduced in intensity as it passes through an absorbing layer were well established in physics long before 1890 when Hurter and Driffield defined density (more accurately *optical* density) as used in photography. It was known that light is absorbed exponentially in traversing a layer of a solution and that the total absorption depended upon the concentration of the substance in the solution and the distance the light had to travel through it. Hurter and Driffield used the same ideas for defining photographic density, although they were aware that a silver deposit in an emulsion layer is not a true solution. Their general approach can be explained as follows:

First they defined the *transmission* of a layer as equal to the fraction of the incident light that passes through the layer. Since transmission is a fraction, it remains a constant ratio regardless of the absolute quantity of light falling on, or passed through the layer. We can demonstrate this convenient aspect of Hurter and Driffield's definition. Consider a developed layer with a given amount of silver, calling incident light I_o and the transmitted light I. The transmission (T) then is equal to I/I_o. Say the incident light is one unit and that the amount that gets through after absorption in the layer is 1/10 unit. (We are ignoring light losses due to surface reflection.) Then T = 1/10 ÷ 1 = 1/10. On the other hand, if the initial light had been 1/10 unit, the amount getting through the same layer would be 1/100 unit, that is, T = 1/100 ÷ 1/10 = 10/100 = 1/10. The transmission remains constant.



Obviously the transmission of an absorbing layer can never be equal to 1.0 because then T would be equal to 1/1, meaning that *no* light was absorbed. This never happens.

You can see that the transmission [the word transmittance is now the accepted term] decreases in numerical value as the amount of absorbing silver in the layer increases. Thus, transmission can be considered as the ability of a layer to transmit light. The "blacker" it gets the less its ability to transmit light.

Since it is more natural to use increasing numerical values for increasing quantities of substance, another term *opacity* (O) was introduced, defined as the reciprocal of the transmission, i.e. O = 1/T. A transmission of 1/10 then becomes 10 in terms of opacity. (*See table right.*)

Transmission (T)	Opacity (O)
1/5	5
1/10	10
1/50	50
1/100	100
1/500	500
1/1000	1000

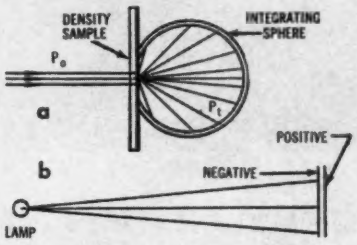
Now suppose we consider what happens when two or more layers of the same transmission are put on top of each other in order to increase the distance of the light path. For convenience, layers having a transmission of 1/10 will be used.

The original light unit is reduced to 1/10 unit by

IT'S ALL IN HOW YOU LOOK AT IT

TOTALLY DIFFUSE DENSITY

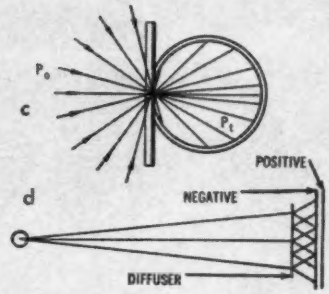
The density of a photographic silver deposit depends upon the characteristics of the incident light and the light-gathering capabilities of the system that "collects" the light transmitted through the deposit. *Totally diffuse density* refers to the density of a silver deposit when the incident light is more or less specular (parallel light rays) and none of the transmitted light escapes the collecting system. The illustration "a" below shows the ideal situation for demonstrating totally diffuse density. The incident light is perfectly parallel, and the transmitted light is completey captured by an integrating sphere



(with suitable opening) placed in contact with the light-absorbing layer. Drawing "b" illustrates a close approximation to the ideal case, which typifies practical photographic conditions when contact prints are made by exposing with near-specular light. The effective density of a silver deposit under these geometric conditions is its *totally diffuse density*.

DOUBLY DIFFUSE DENSITY

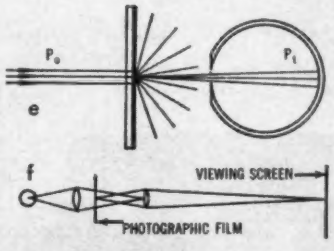
Drawings "c" and "d" illustrate *doubly diffuse density* for the ideal and practical cases. The *incident* light is diffuse; not *specular*. This is the only difference between *totally diffuse* and *doubly diffuse* "density," since the "collector" for



the transmitted light remains in contact with the absorbing layer in both cases.

SPECULAR DENSITY

Removing the "collector" of the transmitted light away from the absorbing layer introduces a fundamentally different geometric situation. Light scattered at acute angles by the silver deposit is now no longer effective because it "was never there" as far as the collecting system is concerned. Diagram "e" shows an integrating sphere out of contact with the absorbing layer. A considerable amount of transmitted light obviously cannot enter the opening in the sphere because of its angular divergence. The integrating sphere receives only specular light rays; thus *less* light than it would collect if placed in contact with the layer. A *lesser* amount of transmitted light implies a higher optical absorption, i.e., a higher density. Diagram "f" shows how the specular density of a silver deposit becomes the effective density in projecting films onto a



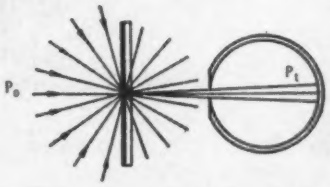
screen. The light scattered by the silver deposit does not reach the screen, which in this instance is the "collector."

A similar geometric condition exists in photographic projection printing. The light "collector" is the sensitive material, which is not in contact with the absorbing layer under these circumstances. Thus, the "density" of the absorbing layer is different from its "contact" density. It is invariably higher if the optical design of the projection printer is everything it should be.

Now since light scatter varies with the density of a silver deposit, it is easy to see why *contrast* is increased by projection printing of a negative in comparison to its contact printing contrast.

TOTALLY DIFFUSE DENSITY

This shows a still different type of density. Here the incident light is diffuse and the "collector" is removed away from the contact



position. Therefore, the effective density of the layer under this geometric arrangement depends upon the small component of specular light that reaches the "collector."

The illustrations on this and the following page are reprinted from the Appendix A1 through A5 of American Standard Diffuse Transmission Density, PH 2.19-1959, *by permission of the copyright holder, American Standards Association, Inc., 10 E. 40th Street, New York 16, N. Y. Readers can obtain copies of the complete standard from the Association. Price is $1.80.*

the first layer. This 1/10 unit then becomes the incident light for the second layer. As mentioned before, transmission is independent of the quantity of incident light, the amount that gets through the second layer is governed only by the transmission of the second layer. Therefore, the final quantity of light getting through both layers is 1/10 of 1/10 = 1/100. (Remember that a silver deposit with a transmission of 1/10 means that 1/10 of the light incident upon it will pass through. Thus, 1/10 of 1/10 equals 1/100 light unit.) It is apparent that transmission values cannot be *added* when films are combined. Neither can opacities. (*See table below.*) The transmission values can be expressed as

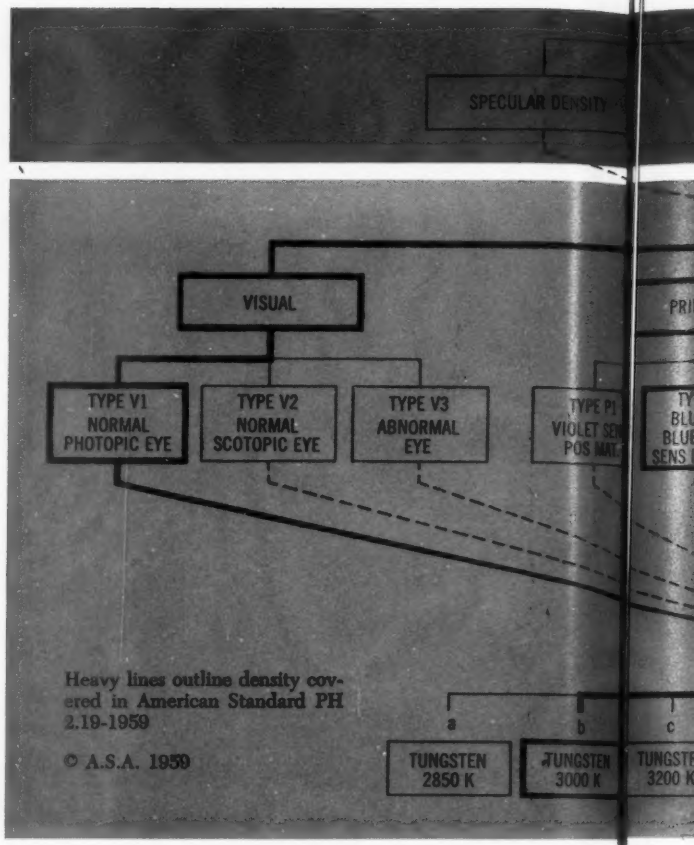
Number of layers each having a transmission of 1/10

	1	2	3	4
Transmission	1/10	1/100	1/1000	1/10,000
Opacity	10	100	1000	10,000

an exponential series, the exponents being equal to the number of layers, that is, $(1/10)^1$, $(1/10)^2$, $(1/10)^3$ and $(1/10)^4$. This clears the way for expressing the light absorbing power of photographic layers in terms of logarithms, which facilitate computation. And density was so defined. Hurter and Driffield put density (D) = $\log_{10}$ O. Density values were shown by them to increase as the amount of silver in the layer increased (a convenience in applying common logic to photographic problems) and were always positive values (a convenience in using the values). The derivation can be thought of in the following way:

We have seen that transmitted light is always some fraction of the incident light and that if an absorbing layer is considered to be made up of a number of unit layers of constant transmission, the finally transmitted light can be expressed as a power of the unit layer transmission. Assuming "n" number of layers, each of transmission 1/10, then $I = I_0\ (1/10)^n$ and $I/I_0 = 1/10^n$. Now, since I/I_0 = transmission (T), and 1/T = opacity (O), then $I_0/I = 10^n$. Now density (D) equals the $\log_{10}$O, or $\log_{10} I_0/I = \log_{10} 10^n$. Therefore, "n", the number of unit absorbing layers within the total absorbing layer is equivalent to density.

In other words, density is a measure of the light stopping ability of a photographic image, possessing these advantages: 1) It does not vary for specific measuring conditions no matter how bright or dim the light falling on the image. 2) It, is a logarithmic function, and it is always positive. Therefore density calculations involve only simple addition or subtraction. 3) It makes

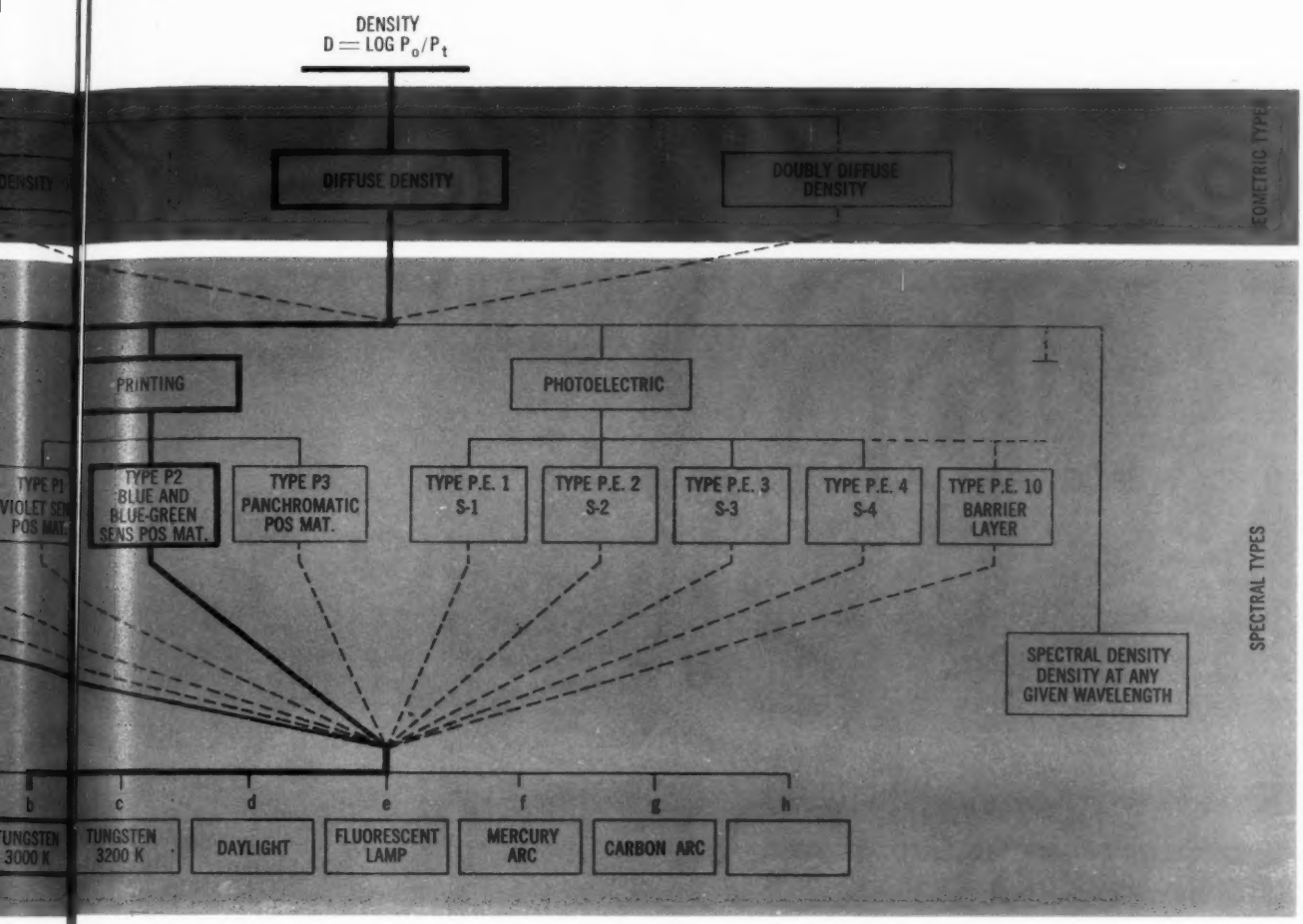


sense psychologically. That is, an image (a silver density area) that *is* twice as high in density as another, *looks* about twice as dense. 4) Although density is derived optically, it can be correlated approximately with the quantity of silver in the image areas measured.

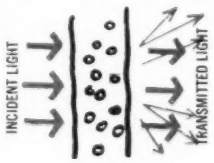
Complications

Unfortunately, density is not so simple as all this when we consider its applications in photography. First of all, a silver deposit is not homogeneous but is made up of a distribution of small grains of different sizes and shapes. These grains scatter the light as it travels through the layer. This complicates the definition of density, for each layer has several different densities according to the nature of the incident light (diffuse or specular) and at what position from the layer the transmitted light is measured. We can consider two examples in way of explanation.

In the following figure is shown (schematically) a layer containing silver particles and the way that specular incident light can be influenced in partially traversing the layer. The light that comes



through the layer is no longer wholly specular, even though it does have a specular component. But most of the light is scattered in various angular directions. The density of the film will depend upon whether or not the measuring device gathers all of the light that is transmitted or only part of it. A photocell placed in contact with the layer could gather all of the light, whereas if placed at some distance away from the layer it would receive only the specular component. In the first instance the density is referred to as the diffuse density of the layer; in the second, as the specular density. Diffuse densities almost invariably have lower values than specular densities.



Another type of diffuse density is one called "doubly diffuse density." In this case the incident light itself is diffuse and the measuring device is in contact with layer.

These variations in the density of a layer are related to the geometry of the measuring method. If we introduce other factors, many further varieties of density appear. For example, some years ago density was determined by visual methods in instruments that allowed a visual comparison of standard amounts of light against the amount transmitted by the sample. When the two amounts were made to match the density was read from a calibrated scale. Such densities have become known as visual densities and obviously they depend upon the relative sensitivity of the eye to different wavelengths in the light source. But a contact print paper, for example, has a far different spectral response from that of the eye, and the density of a silver deposit is different as far as the paper response is concerned.

If a photocell is used for measuring the density the result can be still different depending upon the wavelength sensitivity of the particular cell. And also the light source used in the densitometer has a strong influence on the density measurement. Fortunately, the light source and other details of density measurement are becoming fairly well standarized, and so there are only about four types of density that are of concern to the normal worker in the black-and-white field.—THE END

FEEDING FOSDIC

PMI
MICROFILM SECTION

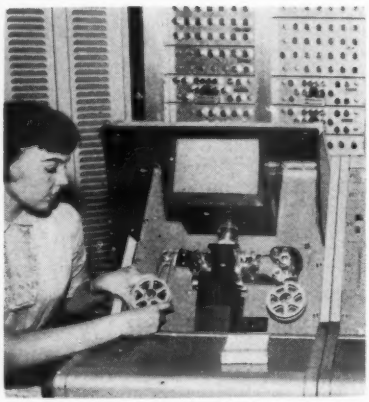
An electronic marvel which turns census data into tape for computer input, FOSDIC digests tons of microfilmed information, provided the film is prepared within strict tolerances. Here is how Census feeds its delicate genius

Processing the tons of data collected during the 1960 Census will be FOSDIC, Film Optical Scanning Device for Input to Computers. It is the brain child of Bureau of the Census and Bureau of Standards scientists. Under this system, data sheets marked by the enumerators will be photographed on microfilm, then fed into FOSDIC. Out will come magnetic tape which will be fed into computers to put raw data into usable form. There is only one trouble with the arrangement. FOSDIC happens to be a feeding problem.

Like many data-processing machines, FOSDIC can distinguish by mark sensing between more dense marks which mean something and less dense marks which mean nothing. However, unless the microfilm is processed carefully, meaningful marks will not show up strongly enough to let FOSDIC record them. The problem faced by Census is quality control of the microfilm input.

The quality control problem revolves about one characteristic of microfilm, its density. If the film is too dense, the difference between light and dark areas will be too slight for FOSDIC to distinguish. If the film is not dense enough, stray marks and smudges will be recorded. In short, the mark sensing will work only within a specified range of density differences.

These limits, as determined by Densichron readings, range between .75 and 1.05. Ideal density is .9 ± .15. The responsibility for establishing a quality control system which would permit the maintenance of proper density, provide a method of checking all phases of production, yet not slow up the processing or exceed allowable costs, rests on Dr. Herman Fasteau, Chief, Quality Control Branch, Bureau of the Census.



Census form on microfilm is fed into FOSDIC where it is scanned by a photoelectric cell. The data are transferred to magnetic tape which will then be fed into computers.

Filled-in circles on census form are recorded by FOSDIC. Black boxes are used to align scanner.

Actually, the 1960 FOSDIC is the third in a line of scanners developed by Standards and Census. The first model, in 1954, read data from sheets which had been marked with special pencils. The 1957 model scanned microfilmed punch cards. In the current model, the raw census sheets themselves are filmed and the film scanned.

No comparable cost figures are available but the services of 2000 punch card operators used during the 1950 Census will not be required. The appropriation for the 1950 Census was $130,000,000; in 1960, it is $110,000,000. If the changing price level is considered, the savings are even greater, since the 1960 dollar is worth somewhat less than the 1950 dollar was. In terms of noses counted, the cost was about 81¢ for 160,000,000 noses compared to 61¢ for about 180,000,000 noses this year.

Far more important from the operational point of view is the great reduction in the possibility of human error and the speed with which census data can be made available. Census estimates that the first data series should be ready for publication by early November, with future series published from six to 18 months earlier than if punch cards had been used.

The first stop for census data will be Jeffersonville, Ind., where the actual microfilming will be done. Formerly a Quartermaster Depot, the location offered advantages of available working space and clerical labor supply.

From Jeffersonville, exposed film will go to the Recordak labs in Washington, D. C., for processing, after which they will arrive at the Bureau of the Census, Suitland, Md., for feeding into FOSDIC.

Planning for this operation began with the search for suitable paper, printing inks and pencils for use with the census forms. The data sheets were designed so that the answer spaces were not superimposed, lest marks from one page accidentally mark up the page underneath. However, the major problems were photographic.

Cameras chosen for the census project were Recordak Microfile Film Units, Model D, using 16mm film. There will be 29 units at Jeffersonville, four of which belong to Census, the remainder being rented from Recordak for the census. Of the 29, 27 will be used with two remaining on standby.

Eight different emulsions were tested before a film was selected, Recordak Type A. One of the criteria was the readings obtained on FOSDIC. A maximum voltage was obtained when this film was scanned.

Development, by Recordak in Washington, is being treated as a constant. Exposure time, based on the 1/42 second shutter speed of the Recordak camera is another constant. The major variables affecting density are illumination and the time lag between exposure and development.

Each operator will check the illumination at his camera with a photoelectric cell. Standard illumination is 60 fc, but this may be varied to fit individual conditions. Each roll of film will be checked in Washington after it is processed and the quality evaluation sent to Jeffersonville. If the density falls below the .75 lower level, a higher light intensity will be used.

Extraneous light which might affect readings will be controlled by proper use of curtains over windows and between camera positions.

Latent image fade is a result of a time lag between exposure and development. With a reading of

(*continued on overleaf*)

TEST AND QUALITY CONTROL STANDARDS

1. This plan prescribes the procedures and the techniques to be used during the January test of Census processing to control the quality of the filming process.

2. Defective product generated by the camera processing is classified into two groups based upon the incidence of trouble: a. Camera functioning and related variables affecting camera functioning such as illumination decrease, voltage change, etc. b. Operator or technician generated defects such as hands in exposure, upside down book, light meter shadow, alignment of stage, etc.

3. The following table provides the sequence in which tests are to be made and the factors and specifications for control:

TEST SEQUENCE	FACTOR	SPECIFICATION
a. Dip test	1) Camera focus 2) Spacing between exposures	Acceptable to technician 3.5 inches ± 1 inch
b. Production Reels—Measurement of density of grey scale chips before FOSDIC	Contrast—Density	Acceptable based on 25.2% reflectance and 88.8% reflectance readings of density and comparison to characteristic curve and adjusted density within tolerance limits of 0.90 ± 0.15
c. Production Reels—FOSDIC Reading	Calibration as measured by failed frames and failed indexes	Failed frames and greater than 1/200; failed indexes greater than 1/10,000
d. Production Reels—Measurement of sample exposures on densitometer after FOSDIC	Density	0.90 ± 0.15
e. Production Reels—Measurement of spacing after density measurement	Spacing between exposures from sample reels and sample spaces	3.5 inches ± 1 inch
f. Production Reels—Visual inspection of reels	Operator and technician generated defects	Excessive error rates as shown by operator ranking

FOCUS: Control — Dip Test, each camera; Inspection — 46-exp. reel; Sampling Unit — 46 exposures; Inspection—visual; Frequency of Test —at random times.

SPACING: Control—Dip Test, each camera; Inspection — 1/3 46-exp. reel; Sampling Unit—two randomly selected spaces within each 1/3 reel; Inspection — visual, measurement; Frequency of Test—random.

CONTRAST: Control — grey-scale chips from each reel and comparison with characteristic curve; Inspection —production reel; Sampling Unit—4 grey chips at end of reel; Inspection—visual, densichron; Frequency —every reel.

FOSDIC READING: Failed Calibration and Failed Indexes: Control—every frame from every reel; Inspection — frames in production reel; Sampling Unit—frames in every reel; Inspection — FOSDIC; Frequency — every reel.

DENSITY: Control—selected samples; Inspection Unit—1/3 of production reel; Sampling Unit—two exposures selected at random from each 1/3 reel; Inspection — visual densitometer; Frequency—every reel.

SPACING: Control — selected samples; Inspection Unit—1/3 of production reel; Sampling Unit—five spaces within each 1/3 reel (every sixth crank on reader); Inspection—visual, measurement; Frequency—one sample reel per shift for each camera.

OPERATOR DEFECTS (hands in frame, skipped sheets, etc.): Control —cluster sample selected from each reel; Inspection Unit—production reel; Sampling Unit—5 clusters of 8 successive exposures; Inspection—visual; Frequency—every reel for every camera.

INDEFATIGABLE MICRO CAMERA

New Air Force camera sets up, photographs, stacks, automatically—By George E. Toles

The Air Force will compress 20 years of microfilming into the next two and one half years with a new high-speed camera system developed for the Wright Air Development Center at Wright-Patterson Air Force Base, Ohio.

More than 5,000,000 engineering drawings of various shades and sizes—some aged and dog-eared—on a variety of subjects from spark plugs to B-58's, will be microfilmed with the unit.

In three seconds the machine unrolls, spreads, smooths, separates, slides and stacks engineering drawings, while the camera automatically centers itself, chooses its lighting, adjusts settings and exposures for uneven line and shading variations, "shoots," loads and sets up for next drawing.

Human fatigue and judgment decisions slow down high volume production with present microfilm cameras. The shortest time in filming a drawing is the camera exposure. Most of the time is spent by the operator handling each drawing individually and making judgment decisions on lighting and camera settings.

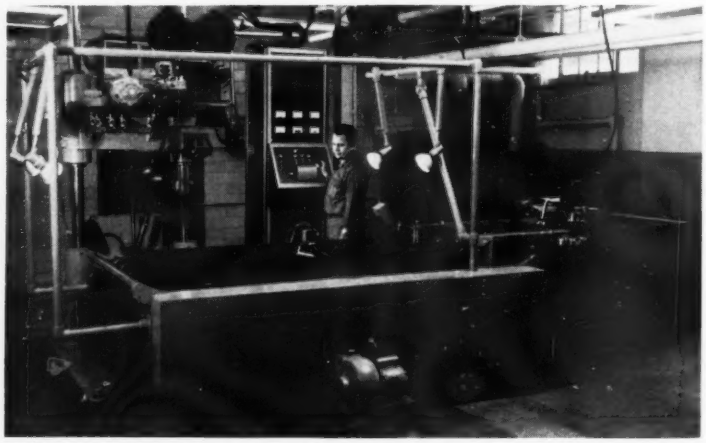
The new automatic camera will film 1200 frames per hour. Manual methods turn out an average of 110 per hour.

The electronic microfilming unit has an automatic feeder with a hopper capable of holding 2,000 drawings of the same size. Suction cups grasp the top drawing, separated from the others by air jets. Grippers on an endless chain clutch the drawing along the top and bottom, and advance it to the copyboard. Through the feeding, grippers hold the drawing flat and vibration-free.

An automatic control stops the entire operation if a jam occurs in the system, and also prevents the camera from exposing or advancing film if there is no drawing on the copyboard.

The new camera uses 1,000-ft. microfilm rolls instead of the usual 100-ft. rolls.

Special controls adjust the camera for reductions, permit the camera to override the settings for drawings that may require special handling, and inform the operator of frame count and unexposed film footage.



USAF camera handles up to 1200 frames per hour—ten times more than manual methods.

60.5 fc, density was found to drop from .95 to .87 in the period from 24 to 48 hours after exposure. Processing and illumination are calculated on this time lag, so that the density loss will not fall below the acceptable lower limits.

Of equal importance is control of spacing, due to the operation of FOSDIC. The census forms have black boxes .15-in. square which are index marks. The beam from FOSDIC starts at a box, then travels down the answer circles, scanning each one and recording the data, skipping blank circles.

The pages, which measure 17⅞ x 14⅛ in., are carefully positioned under the camera in a specially designed holder. The spacing between exposures is set by Recordak technicians at 3⅛ inches ± one inch. Exceeding these limits will result in skipped frames. A dip test, developing a short roll of 46 exposures from each camera at random intervals is expected to reveal spacing defects before they become serious and cause loss of recording time.

The operating schedules are based upon an estimated one complete roll every two hours. Each roll will have about 900 frames, but not every frame will be used, as data from an enumeration district will not be split between two rolls. A new roll will be started for each district.

At the beginning of each roll is a series of four grey bars, used to compare density against the standard characteristic curve of the film. This curve is, ideally, a 45° line having a gamma of 1.

To maintain the uniformity of film stock, only a few days supply will be kept at Jeffersonville. Raw stock will be stored at 70-75° F.

Developmental work on FOSDIC covered a ten-year period, with E. L. Stein and M. L. Greenough playing prominent roles in the project. Each FOSDIC (there are now five, four in use and one standby) cost $125,000 to build, plus an estimated $250,000 for developmental and research costs.

As of this writing, FOSDIC is the only machine of its type, according to the Census people, typical of the pioneer work done by the Bureau in data processing. The first UNIVAC was made under contract at Census (it is kept at Suitland as an exhibit) and the needs of the Census hastened the development of punch cards.—THE END

MICROFILM IN THE DEFENSE PROGRAM

PMI
MICROFILM SECTION

A standardization plan for the use of microfilm by Army, Navy and Air Force may prelude a giant step toward engineering data miniaturization

If a person worked at it eight hours a day, five days a week, for about 58 years he could count all the current annual consumption of engineering drawing prints used by the United States military establishment.

These prints—a billion of them every year—are used constantly, to develop weapons, to produce them, to test them, to inspect them and to keep them in repair. One might say that our defense posture is propped up by them. Today these prints exist as blueprints, diazo prints, Van Dykes, offset reproductions, microfilm originals and dupes. The cost of the six million new originals has been estimated at $1.5 billion annually—with the cost of the reproduction at a half billion—or more, because in the race for a more efficient military no one has time to tally the actual numbers or costs.

John J. Dunn, Assistant Chief of the Standardization Division of the Armed Forces Supply Center, in a speech before the National Association of Blueprint and Diazo coaters stated the problem this vast amount of data poses: "A complex arterial system of modern methods must be instituted to prepare, reproduce, transmit, read and store this data . . . (their handling) requires the development and institution of an automated microreproduction system throughout the entire DOD . . ."

In this connection, a Department of Defense letter authorized in August of 1958 a committee to study the requirements of engineering drawing microreproduction systems. In July of 1959 another Department of Defense letter superseded this and set up an "area assignment" for standardization.

The current standardization plan for engineering data microreproduction systems—EDMS at the Pentagon—released January 18, covers the fiscal years through 1962.

In itself, this plan is a large undertaking, involving at least 11 subdivisions of the military, 14 interested industrial organizations and 52 existing civilian and military standards, specifications, handbooks and tables.

Specifically, the plan outlines 16 projects including specifications, standards and a handbook with target dates ranging from March of this year to March of 1962. Covered in the specifications are: 35mm microfilming of drawings, lists and specifications, 105mm microfilming of construction drawings and maps, the preparation of aperture cards, the entry of data on aperture cards, photographic film, diazo and vesicular film. The handbook is intended to cover the requirements for guidance to draftsmen and reproduction personnel in the preparation of copy to be microfilmed. Standards included cover the format and coding of aperture cards, the requirements for an inspection gauge and the requirements for storage of engineering documentation. Other projects include evaluating the performance characteristics of equipment, the use of microfilmed data in lieu of original documents, automatic data processing for air weapons systems, records and procedures and a study of drawing procurement.

According to Russell Eaton, Jr., of the Air Material Command, "The development and implementation of this plan will affect all military contracts negotiated by the Departments of the Army, Navy and Air Force when engineering drawings, associated lists and related data are acquired in film or aperture card media."

What about the drawings that are not to be microfilmed? Dunn gave an answer to this: "Herein is the key to the whole system approach: standardize the basic factors affecting end use without encroaching upon the prerogatives of the individual users (in the DOD) for their internal data management systems."

Dunn's "personal observation" is that within the next three years 80 to 90 per cent of *new* engineering data will first be reproduced on microfilm. This prediction would not hold for the 50 million or so drawings now in DOD files. Dunn's remarks were carried in the December, 1959, issue of ***Filmsort Facts***. Reprints may be available from Filmsort Div., 3M, Pearl River, New York.—THE END

PMI
MICROFILM SECTION

Guiding Sun Shipbuilding and Dry Dock

to a more efficient method of building ships,

a tiny beam of light traces lines from a

photographic plate ten inches square

in a steel plate 57,600 inches square

GUIDING LIGHT

The guiding light in this case is a pencil-point beam from a photo-electric cell, following the pattern of lines on a photographic plate as it directs a flame-cutter at the Chester, Pa., yard of Sun Shipbuilding and Dry Dock Company. Every line on the plate, a photograph of the loftsman's original drawing, is transcribed by the torch on a steel plate. When the torch has completed its guided tour, the steel section will fit snugly into its proper place aboard the ship as if it had been custom tailored.

The $400,000 installation, consisting of four Schichau-Monopol machines developed in Germany, is the first in operation in any American yard. (Similar equipment is being installed at Todd Shipyards' Los Angeles yards.) It is basically a giant tracing set, lines from a 4cm x 12cm picture being traced in fire on a 10 x 40-ft. steel plate. Heart of the system (or brain, if you prefer) is the photographic plate, a picture of the drawing of the part, reduced 1/100 actual size.

(The loftsmen develop their draw-

Preparing plate, *(left to right)* Sun photographer Joseph Grant places loftsman's drawing on vacuum easel. Drawing, to 1/10 scale, is photographed with a Stroblex camera using 6 x 15cm Kodalith plates. Large ring in front of camera is before-the-lens shutter. Plates are developed with exacting procedure. Plate is shown slightly reduced. Heavy boxes at each side of plate are used to check alignment. There are no tolerances permitted since errors would be magnified 100X.

ings to 1/10 scale which is reduced a second 1/10 during the photographing. The result is a 1/100 scale representation of the part.)

This degree of reduction imposes one stringent condition on everyone concerned with the operation; complete accuracy. The loftsmen draw their lines .4mm wide on dimensionally stable Cronarflex or Agfa Correctostat (which has an aluminum center between two sheets of paper) in an air-conditioned room. Once the drawings are completed, they are given to the plant photographer who has the complete responsibility for producing the plate.

The photographer who carries this responsibility is Joseph Grant, a veteran cameraman who has been handling general photographic work with Sun for 20 years. He not only does the photography but is his own quality control lab. There is zero tolerance. If a plate is not perfect, it goes back to be done over. Every operation in this lab is designed to maintain these high standards, no mean feat with a weekly workload of up to 500 plates.

The photographic equipment furnished as part of the Monopol installation consists of a camera mounted on a stand, a rail, two vertical electronic flashtubes for lighting the vacuum easel which holds the 2 x 5-ft. drawing.

The actual photography is simple. Once the drawing is lined up on the easel (index marks at top and bottom mark the limits), Grant turns on the electronic flash unit. The camera has a before-the-lens shutter which is synchronized with the units. When the proper charge is built up, after about two minutes, Grant takes his picture at 1/500 sec., the speed of the flash. The lens on the camera is a 24cm Apo-Tessar f/9, used wide open.

The plates, specially prepared by Kodak in the required 6 x 15cm size, are developed in Kodalith developer. Formerly, Grant used a Belgian product but found that Kodalith Type 3 gave greater latitude and better resolution. Development of the proper emulsion took about a year, with Kodak tech reps shuttling back and forth between Chester and Rochester. Thirty emulsions were tried before the present one was adopted. Sun orders 60 dozen plates at a time.

Development is from 110 to 120 sec.; 20 sec., agitation at first, then no agitation with plates resting flat, face up, in still developer. Temperature is 68°F. and a 1A (red) safelight is used for inspection. After development, there is a 3-min. rinse in non-hardening fixer and a 10-min. water rinse. A Lumo drying cabinet, part of the Monopol kit, is used to dry the plates.

It is essential that development be kept within a very narrow range, thus keeping the width of the lines on the plate constant. Grant found that overdevelopment could close the lines from 2/1000 to 1/1000 in. while underdevelopment can open them from 2/1000 to 4/1000. Occasionally he will use this phenomenon to improve a line slightly, but generally, he tries to vary processing as little as possible.

Once the negative is dried, Grant examines it carefully, using a magni-

(*continued on page* 98)

Grant checks finished plate carefully before locking it into holder. Plate must be perfect; no tolerances are permitted since each error would be magnified 100X. Monopol machine is used, with operator checking light beam in console before starting cut. The light, moving along the lines of the plate, controls the burning arms to cut a pattern in steel exactly as the drawing on the plate. Paper above operator is copy of drawing for checking cut.

by Vernon D. Tate

MICROREPRODUCTION

A preview of the 1960 convention of the National Microfilm Ass'n.

The Ninth Annual Meeting and Convention of the National Microfilm Association will be held April 19-20-21, 1960 at the Statler-Hilton hotel in New York. The complete "Penn-Top" facilities have been reserved for exhibits and scheduled meeting rooms. The convention will bring together manufacturers of equipment and supplies, service companies, executives, government officials, technicians, scientists and documentalists for a carefully planned program. Research and technical papers, application studies, discussion panels and related functions will be featured. This convention is the high point of the year for the Association, its members, guests and all other active or interested in the field.

Fast pace

The decade of 1950-60, just concluded, witnessed extraordinary growth and development of the field of microdocumentary reproduction. The decade just beginning will see continued use and expansion on a scale that now can only be estimated. Even before World War II microphotography had achieved a solid foundation as an efficient and accepted method in the management, control, use and preservation of records. Its use was widespread and growing throughout business, industry, all levels of governmental operation, archival, library and research fields. World War II not only proved the effectiveness and versatility of the technology but also demonstrated their utility in myriad new connections. As one use and application has led inevitably to another, the art and science of microreproduction stimulated invention and the development of new materials. New methods and equipment appeared and were applied to an ever widening circle of problems. No one really knows the whole story but the 1960 Convention affords an ideal opportunity to see and to learn at first hand. It is the best way to keep up-to-date.

Exhibitionists

Well planned exhibits are always a focal point of interest, for the ability to see and compare a large segment of the physical implementation of a technique in one place and at one time is an education in itself. Of the 75 booths available, at this writing, virtually all are reserved. The exhibits are highly varied in character and range from the smallest units or components to the very largest complete machines and even combinations of machines into systems. Not all of the items shown are of American manufacture, for a large selection of foreign products representing the best available equipment originating outside this country will be included. Several manufacturers have timed first announcement and showing of important new developments for the convention.

Cameras, processing equipment, printers, reading machines and other basic tools for all variations of microreproduction and intended for many general and special purposes will be on view. The newly developed reader-printers which were a sensation last year will be back in improved models. A system of single step processing for microfilm wherein developing and fixing chemicals have been combined in a single solution will be demonstrated publicly for the first time. The growing practice of unitization, ranging from single unit cards for machine data handling and processing to all varieties of jacketing for simple and automated systems will receive considerable attention. There will be many pieces of important and hard to find accessory equipment including densitometers, hot splicers, small optical units, projectors, storage equipment and the like on display. The motto of the Exhibit Committee "If it is used in microreproduction, it belongs on exhibit" has been pursued rigorously and successfully. The list of exhibitors is much too long to reproduce here but it is a "Who's Who" of manufacturers and suppliers to the industry.

Program themes

The program has been planned around four central themes: *Tools, Applications, Problems* and *The Future.* The first sections obviously amplify and extend the exhibits, for many of the elements discussed in a series of concise factual papers will be illustrated in the exhibit hall.

An important phase of *Applications* will be a full description by a high ranking Air Force officer of the Department of Defense Military Specifications and Standards for use in the procurement of equipment and services on governmental contract. The unitized card will receive particular attention in his presentation. The DOD Specifications and Standards will be further discussed by a panel of experts who were concerned with their preparation and administration. All of the aspects of preparing and submitting invitations to bid on contracts, engineering drawings, changes and related topics will be of great interest to technicians and potential suppliers. They are of equal importance to non-governmental agencies with similar problems.

For inquiring minds

Other sections of the program will deal with frank appraisals of present methods and facilities in connection with a wide range of applications. Archival, library and documentation problems are scheduled for a separate session. The shortcomings of present methods will be freely discussed as a prologue to the consideration of potential improvements. In every instance time has been allowed for questions. Participants have been urged to bring questions in written form to the meetings. They will be transmitted to the appropriate moderator for inclusion in the discussion period.

Forward look

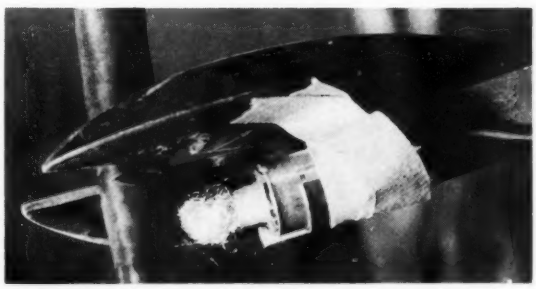
The future will receive attention by well qualified and informed speakers. Some of the topics in this section involve the future relationships of microfilm and magnetic tape. What is the future of mag-

(*continued on page 66*)

PMI's Monthly

READERS' SHOWCASE

Life would be simpler (and photographers poorer) if people in management did not get ideas for pictures of unphotographable items. One way photographers earn their keep, however, is to solve these minor problems. At Goodyear Atomic Corp., Portsmouth, Ohio, the safety people wanted to show what happens if 440-volt cable is cut. This was a problem for plant cameraman Donald J. Landstrom to solve; after all, realism can only be carried so far and you just can't go cutting cables. His solution was to attach the base and foil from a flashbulb (he removed the glass bulb from the base) and attach it to the rear of a pair of snips. He then fired the bulb from a 110-volt line. The snips were lit by two 150-watt spots. Exposure: two sec. at f/22 on Super XX sheet film. The print, used for a poster, is a vivid reminder to look before you cut. The picture below shows Don's set-up.



Occasionally we get nosey and ask why cameramen submit pictures to Showcase. The answer usually involves the element of recognition; after 9000 anonymous pictures, it's nice to get a credit line. No cheapskates we, the $10 fee is still paid. In some cases, such as this month, we will pay more because we have two pictures, one the photograph used, the other, a how-it-was-done shot. Whether you have one, two or ten pictures, submit them to Showcase, PMI, 33 W. 60th St., N. Y. 23, N. Y.

A SWITCH IN TIME

A pioneer in electrical manufacture, Cutler-Hammer, Inc., pioneers in data handling with a switch to microfilmed engineering drawings. In this paper, originally presented to a University of Illinois Drafting Seminar, C-H's J. E. Jones tells the why's and wherefore's

Keypunch

Filming

Reading

PMI
MICROFILM SECTION

This paper deals with the various phases of the application of microfilm to engineering drawings. I must, of necessity, refer to what we are doing at Cutler-Hammer and hope you will overlook the frequent reference to it. We have two engineering and drafting areas in Milwaukee. These produce about 16,000 new drawings and 35,000 changed drawings per year. Prints of the drawings serve four plants in Milwaukee, one in Lincoln, Illinois and two on the West Coast. The needs of our customers plus our own needs require us to make about 400,000 prints of drawings per month including both "standard" and "special" drawings.

Since drawings do not all have the same value or importance, it is well to classify them as to types. Procedures can then be established to handle the various types of drawings based upon the needs. In your company, you might establish several categories or types of drawings. However, for this discussion, we will consider two general types which apply to some degree in most companies. First, and most important, are the "standard drawings." In our business, these are the device or component drawings and the various standard structure drawings. They are the building blocks which we use repetitively in building special assemblies and engineered systems. They enjoy a long active life as components and require a still longer life for renewal parts service. They are the "bread and butter" of the business. The second category covers "special drawings." These are usually made for specific orders from our customers. We do not expect that they will repeat in exact form, although duplicates do occur. Their active life, in general, is during the building and installation of that particular system. After that, they are available on a "seldom needed" basis for reference and for renewal parts service.

All drawings are important to the company and to the users of our equipment. However, they do merit separate evaluation in an over-all study of a microfilm program. Each category of drawings can then be fitted into the over-all plan adopted, in a manner that is commensurate with the actual needs.

This paper will deal with drawings and the microfilm of drawings under the broad topics: **1)** Security. **2)** Space saving. **3)** Reference. **4)** Print service. These are discussed as they apply to small and medium sized companies, in which class I place our firm.

Our microfilm program of drawings was started in 1941, at the time when many companies gave a lot of attention to the protection of those very valuable documents. All drawings, engineering data, and supporting specifications were filmed on 35mm film. The film was stored in a remotely located vault. Each year our maintenance filming of new drawings and revisions on old drawings amounted to about 50,000 frames. All films were stored in roll form. A roll index system, coordinated with our Parts Index, enabled us to locate the roll on which the latest revision of the drawing was filmed. In 1953, a Record Committee undertook a study of the above four broad topics as they apply to drawings and prints from drawings within Cutler-Hammer. It was necessary to establish policy decisions having the approval of top management. Then followed studies of available equipment with evaluations to determine what best fitted the needs under the policy. Within a period of four years, the Records Committee completed its studies and recommended equipment and set up procedures which included: **1)** A new and then novel print distribution system. **2)** A complete microfilm reference file for a major department. **3)** A drawing destruction program. **4)** A revised microfilm system for drawings. The drawing microfilm is a part of all of these.

The four broad topics will now be considered individually in the light of their development up to their present status. This requires some retracement over the same ground but for specific purposes.

Microfilm for security

This requires definition and the definition used will vary from one company to another. A company may elect to look for security from fire and water loss or may go all

the way for protection against a major disaster. The factors which enter into the decision are different for a small company having one site of operation than for a large corporation which operates in many localities. A small company might reason that a major disaster in their locality would wipe out their plant and personnel so completely that preserving their drawings is of no great interest. This is a policy matter to be determined by each company. Having determined the hazard against which you plan to protect your drawings, you are next faced with the form and procedure which you will employ for maximum benefit. We decided that the great number of drawing revisions which we make just about rules out the idea of having security film in rolls. Sorting out the latest revisions in the event of necessity, would be next to impossible. We have elected to card mount our security film and to keep only the latest revision.

Another problem present in the case of disaster is that of sorting so as to restore the most important drawings first in getting back in business. In our case, we certainly would need our standard drawings first. Further, there are certain classes of our standard drawings which should have preference. For efficient utilization of blow-back or enlarging equipment, we should be able to sort out the drawing sizes. All of this is accomplished by mounting the film on tab cards which have the necessary sorting information punched in them.

Microfilm for space savings

The value of microfilm for space saving is well known and widely used. This is realized to the fullest when the originals are purposely destroyed. The present day improved quality of microfilm images has given engineering departments the courage to actually destroy drawing originals. A drawing destruction program can operate much more effectively if the microfilm is stored in cut form rather than in roll form. A series of drawings, even a modern series, contains many inactive drawings which can be destroyed. Inter-filed with these are active drawings, some needed for renewal parts and some having patterns and tools. It can be seen that spot drawing destruction year after year, with coordinated microfilming, will soon render a roll film file almost useless. On the other hand, such spot destruction is conveniently done if the security file has cut film which permits the latest transaction to be maintained on an individual frame basis.

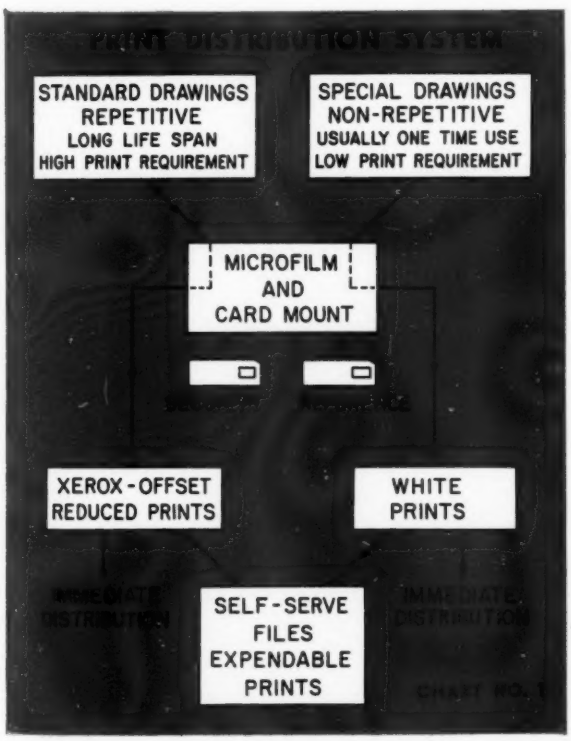
Our cut film system will make it possible for us to destroy drawing originals, at least as fast as we make new ones. This will be a worthwhile consideration in an increasing industrial activity during the years ahead, in terms of saving floor space and file cabinets.

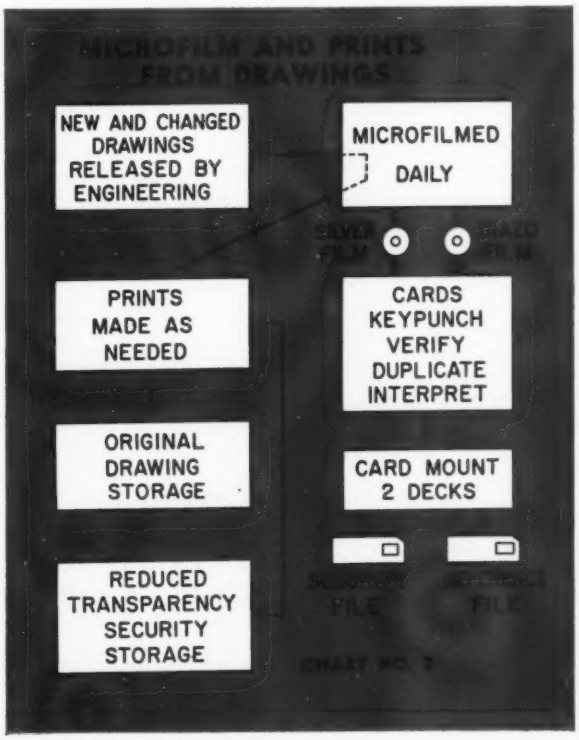
Microfilm for reference

A working file of microfilm has exceptional merit for reference purposes in some situations. When a group or department needs ready but infrequent reference to a large volume of material, an ideal situation for microfilm exists. This is, of course, related to the space saving consideration, but cost saving and improved performance are perhaps even greater benefits.

Our Renewal Parts Department must handle inquiries and orders involving equipment built since the turn of the century. They need access to original order papers, engineering data, specifications and drawings, of all vintages. For efficiency, all of this material should

(*continued on page* 76)

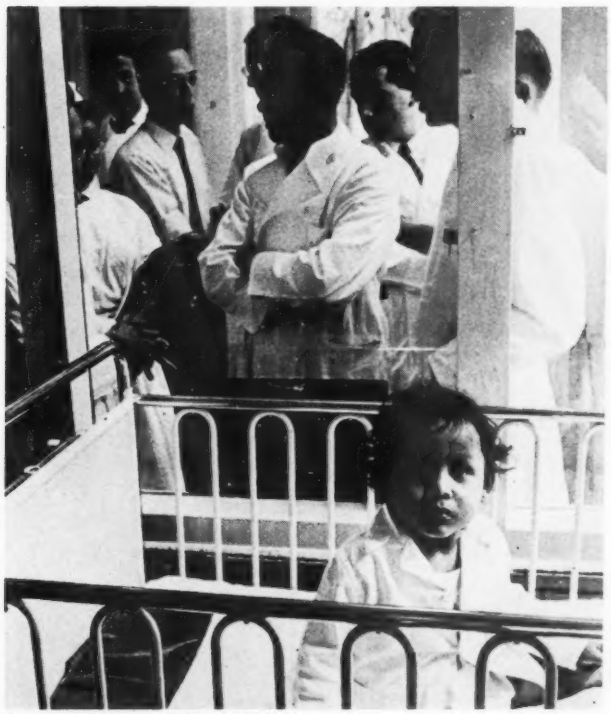




Child health clinic: Syria

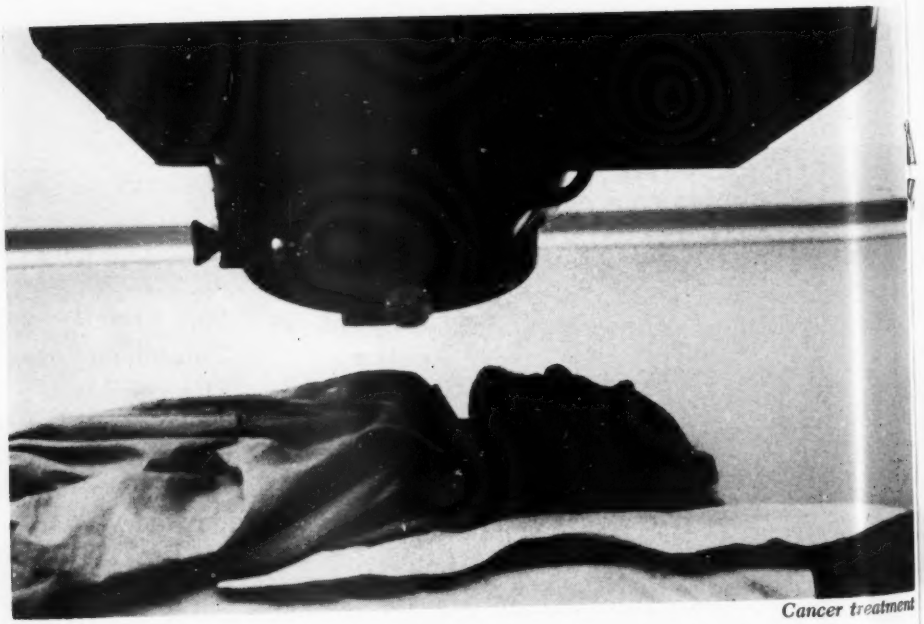
NO. 21 PORTFOLIO

The United Nations might be compared to a circus; in the center ring is the General Assembly, catching the audience's attention with temperamental stars and a continuous tumult. Off to one side, in smaller rings, are the journeymen performers of the specialized agencies, in this case, World Organization, WHO. A joint effort of UN member nations, WHO works to improve living conditions, fight disease and raise medical standards.



Pediatric training: Netherlands

To communicate the ideas and the purposes of WHO, use is made of photography; not the nuts and bolts kind but the journalistic kind which is unexcelled for conveying not only information but an impression. Anyone looking at these pictures knows the what and the why of World Health Organization. All are from WHO publication.



Cancer treatment

Health education: Brazil

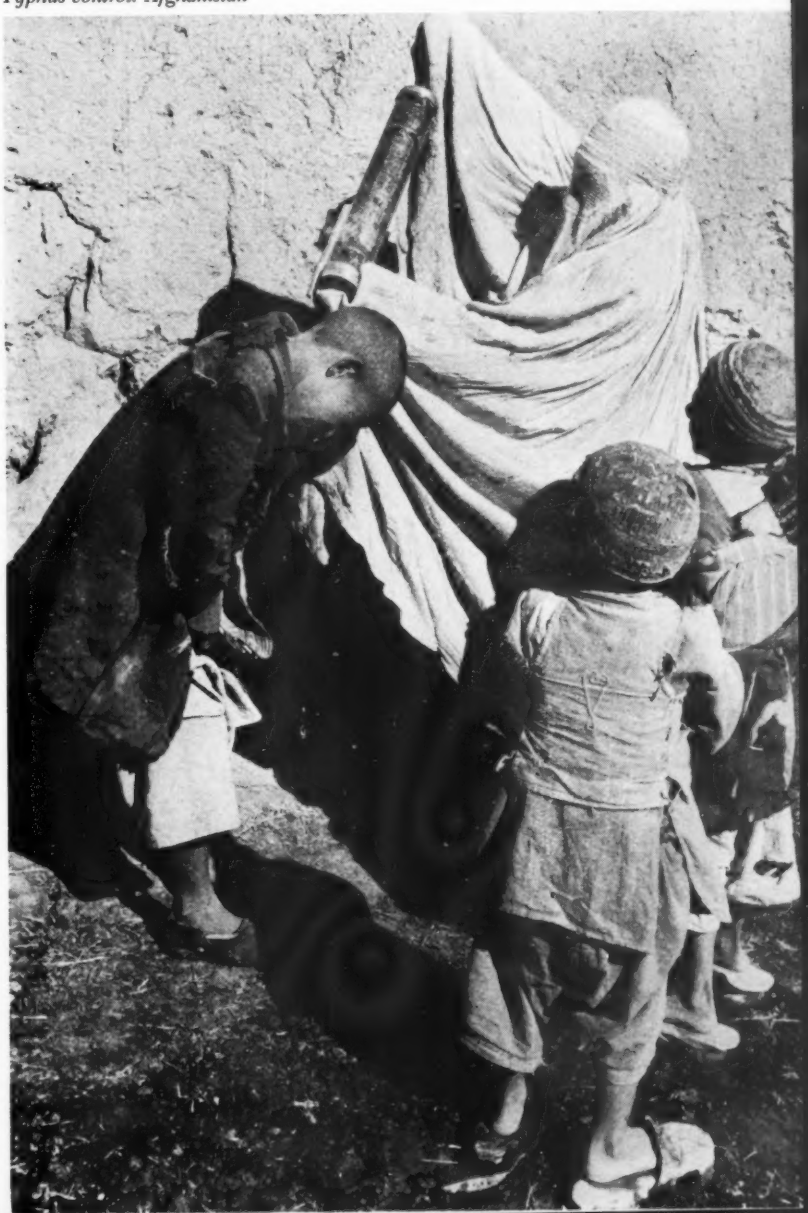
The relationship between WHO and photography in industry is that both have to create in the eyes of observers a sympathetic "feel" or attitude for an organization and the work it does. It is a type of photography which is not too common in industry, although not as rare as it was some years ago. Technically, it is fairly easy; in most cases, a miniature camera and available light are all that is needed.

Psychologically, it is very difficult. Not only does the cameraman have to understand the story to be told, but he must have a sense of drama. Each photograph has almost to tell the story itself, to impress the viewer with the importance and the needs of the subject. An empathy is aroused which causes the viewer to react as the photographer desires—sympathetically, mockingly, casually—the feelings are transmitted and the message is understood.

The best photo journalists have this talent. Too few industrial cameramen do. Perhaps the purely technical and record photography, still a major part of any plant photographer's workload, buries the sensitivity needed for this type of work. In practical terms, this results in a firm using plant people for routine work, then getting a high-priced specialist in sensitivity for important assignments.

All the photographs here were made by freelance people hired by WHO. Perhaps industry is not as pathetic as a sick Arab but it is no lo less human. This humanity should be photographed.

Typhus control: Afghanistan



THE PUSH

As any photographer knows, there is a reserve of sensitivity in all black-and-white and most color films on the market. When quality is the last consideration effective film speed can be increased by a factor of 10 to 100, depending on the variables involved. Here is a review of the techniques and the pitfalls in pushing a film's sensitivity

Recently a photographer was asked by his company's engineers to shoot a pattern of exhaust gasses from a model jet engine. He decided upon a shadowgraph, and constructed a spark light source of sufficiently short duration to still the blast of moving gas, then exposed his film out of doors on a moonless overcast night. The problem was that the light source, when fast enough to stop action was too weak to make a good exposure on the fastest film this photographer could lay his hands on. It was a dilemma that one may assume recurs often these days when photography has such an important role in research and development. This particular photographer's solution was to use well-known techniques to push his film beyond normal performance.

Although research is reported from time to time on the sensitivity of specially grown crystals of silver halide to aid the study of latent image formation, this is only of academic interest to the photographer in industry who buys his film in packages and who needs more than one crystal of silver halide to make a picture. What many photographers would like to know is how far commercially available films can be pushed and still be usable for specific purposes. This article is addressed to that question, and the means known for increasing the effective speed of a film.

Nearly all the information was obtained from photoscientists who are themselves wrestling with problems in increasing the effective speed of camera films. These men are all anxious to point out that the piper must be paid when films are pushed beyond the performance for which they were designed. The penalty is usually a combination of poor tone rendition, graininess and loss of sharpness. Therefore, they exhort the photographer to ask himself three obvious questions before trudging up the slippery slope of forced processing: 1) *Is there any way of improving the lighting?* Choosing a more photographically actinic source, bringing the lights closer and, if development is to be increased, making the lighting flatter should all be considered. 2) *Can I get and use a faster lens?* 3) *Can I alter the subject to make it more visible in the photograph?* As one expert in the business stated, painting a greasy gizmo with a fresh coat of white does wonders for its powers to generate an image.

Still there is a theoretical limit to the relative aperture of a lens (f/0.5), and you cannot paint up and light up a distant nebula, a bank robber or a cathode ray oscillograph trace, although photographers make pictures of them all the time. What, then, are the sensible means of increasing the sensitivity of the commercially available photographic processes?

The obvious one is to pick a faster film. In most instances this is sufficient, but under discussion are the remaining cases where this expedient is not enough. When it is not, some extraordinary treatment is called for—and this makes it a complex subject.

Generally, the experts interested and interviewed seemed to be in agreement: the photographer is likely to be better served with a fast film pushed little than with a slow film pushed for all it is worth. However, one man long acquainted

with the black art pointed out that where only a minor difference exists between two fast films, the photographer is likely to have a better time of it with a film with which he is thoroughly familiar, particularly when he is in no position to make exhaustive tests merely to get one picture of minor utility.

The same man said he had yet to hear of a film that gained speed or reduced its propensity toward fogging while stored. Treat film like a head of lettuce, he said; buy it fresh and keep it cool.

Pictures at minimum exposure may force the photographer to deal with high-intensity or low-intensity reciprocity law failure, which may reverse the speed advantages of one film over another. (See *Reciprocity Failure,* PMI: *January, 1958*). Films vary too in their sensitivity to colors and invisible radiation, and this fact may be as important a consideration as sheer speed itself.

Once the photographer has made a selection of his film or films, the next prudent decision is to make careful tests of all his variables. One matter of common sense is so easy to neglect that it deserves mention. Evaluate the results the way they will be used ultimately. If intended for printing, test prints should be made; if intended for use on a motion analyzer, the test films should be evaluated on the analyzer. The pictures on this page are an example. *Readable* negatives required a stop less minimum exposure than *printable* negatives.

Films vary slightly from one emulsion batch to another. The extent of the variation is so small that it rarely affects black-and-white photography and poses only minor difficulties for the color user. Extraordinary processing intended to push film to near the limits of its speed potential, however is likely to exaggerate the minor batch-to-batch differences. It is therefore important in zeroing in to use film of the same emulsion batch as will be used in the final picture taking.

There are a number of means known to increase the effective sensitivity of films.

In the case of motion picture photography mechanical difficulties usually limit the means to two, at least in the minds of the workers interviewed—namely, extended development in a normal developer and extended development in

The subjects in this demonstration of forced film speed, two subjects were photographed under identical light on a single roll of film

E.I. 16,000 The film, 35mm Isopan Record, was developed in D-19 for 20 min. at 70°F. Above frames were exposed at equivalent of E.I. 16,000

E.I. 32,000 At the limit, all the "information" on the high visibility subject still can be read, where other subject drowns in a sea of fog

a more energetic developer than usually used.

Some regard these methods as the most practical means for still photography as well.

The point of both procedures is to develop more and more of the silver halide that was exposed less and less. Since an area of total absence of light is seldom present in ordinary scenes, each part of a film received *some* exposure to light, and overdevelopment might possibly go on ad infinitum. There is, however a zero point, the threshold of exposure below which the crystal is inured to the action of light and no more nor less susceptible to development than a totally unexposed neighbor. Another limiting factor is a point of no return where the developer indiscriminately reduces both unexposed and exposed crystals, producing fog at a rate faster than it develops the image. At this point fog beclouds more image than the development produces. In the region of relatively greater exposure, development continues to build density, adding contrast to the total image.

The balance between the factors which have opposite effects on the development contrast of the total image rests at the highest point on the familiar time-gamma curves. The curve levels off at this point and additional development results in no more, or even less, gamma. Most curves are not carried out to this point, but for *maximum* speed the point has little bearing. Gamma, by definition, is determined by the straight line portion of the D-Log E curve, and the photographer making a college try for sheer speed will most likely attempt to extract all image possible from the toe of this curve. In consequence he will develop beyond the maximum gamma for the image considered as a whole. A project whose results were published in *U.S. Camera* and later revised and published as a data booklet by the Eastman Kodak Co., indicates that attempts to extend speed a stop or so result in better quality using standard development in standard developers.

Beyond this, the photographer could resort to overdevelopment, up to a point where he might better switch to a specialized developer—except in color work where no one is willing to guess that any but the prescribed developer will do the job.

One type of developer is singled out for study in connection with processing for maximum speed, the high energy, low fogging, non-silver solvent and non-staining type characterized by the X-ray solutions and formulas as Kodak D-19 and Ilford ID-19. Compatible with their other qualities, their contrast is not excessive.

Of special interest in this area is Kodak Developer SD-19a, which contains an agent, hydrazine dihydrochloride, that makes powerful D-19 even more powerful. Unfortunately, it also increases the grain and the fog of the finished result, over and above similar treatment in D-19. The formulary is reprinted in the *Photo-Lab-Index*. It appears in the classic "Methods of Increasing Film Speed," by H. A. Miller, R. W. Henn and J. I. Crabtree in the *Journal of the Photographic Society of America,* Vol. 12, pp. 586-610, No. 10, November, 1946.

Since many professionals have their color work sent out, when confronted with a necessity for increasing the speed of the material, they must seek a custom finisher willing to and experienced in extending first development. The practice compensates for underexposure of one, two or three stops. Again a test is necessary, and the photographer must steel himself against rough image tone, color shifts and a loss of maximum density—the result of fog and the solvent action of the first developer. The paraphenylenediamine developers necessary for negative color processing reduce its speed ceiling well below that of the reversal materials now marketed.

The inherent defects of extended color processing are usually more objectionable in motion picture work. This lowers the ceiling still further in this area.

The film manufacturers offer instructions for increasing first development (and adding a base to the color developer in some cases) for consumer-processed transparency films.

Aside from extended development, there are a number of techniques known to photoscience for squeezing the last ounce of speed from film. All are familiar because they were introduced when films were not fast enough to expose scenes now considered all-in-a-day's-work.

From the standpoint of ease of application, the first is pre- or post-exposure to non-image light. Applied to increasing film speed, the purpose of this treatment is to lower the threshold of exposure below which the crystals of silver halide is undevelopable. Because a variety of crystals is present in every film there is a double action. Some very sensitive crystals are merely fogged. Others are not affected. Some become more sensitive to slight exposure—the point of the procedure. Careful experimentation can reveal the best mix—namely the greatest gain in speed at the least expense in fog.

This is hypersensitization or latensification depending upon when applied, before or after the primary exposure. The technique is not limited to the action of light. (*continued on page* 96)

MEMO ON: TRAINING

Learning photography in industry is still a do-it-yourself deal. All it takes to be a cameraman is one bright, ambitious kid, hard work and a willingness to start at the top—of a broom

As far as most firms are concerned, "they ain't no such animal" when in-plant photographic training is discussed. Most photo sections are staffed by experienced or semi-experienced people when vacancies occur. In those cases where beginners are hired, an informal look-and-listen method of learning while you work is used.

This system, despite its defects inherent in any haphazard operation, has two practical advantages. From management's point of view, it is cheap. Photo people are a minute proportion of the labor force in most large companies and it just is not possible to establish a training program for one man or send him to school when there is no assurance that he will stay with the company long enough to repay his tuition costs.

For the supervisor, it provides a sort of natural selection; if a young employee is interested in photography, he will make the extra effort to learn. If he is not, at least the darkroom is swept and old chemical bottles removed.

The look & listen method is favored

In practically all cases checked, however, an applicant for a photo job has had some experience or knowledge, whether from military service, as an amateur or as a beginner in a photographic establishment. The amateur-service background appeared in practically every photo supervisor interviewed, most of them having had fairly good studio or commercial experience before coming to industry. In essence, the industrial cameraman is a skilled, highly specialized individual. Few corporations can devote time and money to train so small a group of workers. They must bring their training with them when they are hired, usually away from a less attractive photographic job. (An informal survey indicated that the most common lure, not surprisingly, was more money.)

Training is generally accomplished outside the plant, in photography schools or courses, in special workshops and seminars and, for photo management, at various management institutes where specialization ends and line responsibilities take over.

Cameramen bring training along

In certain highly specialized areas, as in photogrammetry where previous experience may not cover highly technical applications, special classes or lectures are sometimes held. Even these, however, are apt to be on an occasional basis, given as time and workload permit. In rare cases, supervisors are sent to take specialized courses.

Virtually every supervisor interviewed had reservations about the value of photographic trade schools. One reported that he quit a course in disgust; he knew more than the instructor. Some felt that the basic introduction was of value and that they were useful for teaching specialized subjects—color printing, etc. A few gave more consideration to applicants who had a degree from a university with a photography major. All agreed however, that the important factor was the man involved, whether he really liked photography, whether he had the required taste and temperament to develop into a good industrial photographer.

Virtually all respondents agreed on the value of special short courses where a phase of photography would be discussed by experts in terms experienced photographers could appreciate. Typical of these courses are the various subjects taught at Winona, manufacturer's schools such as the Leica School, or the training programs and seminars of Eastman Kodak, Tecnifax and Calvin—or short courses at various colleges such as Kent State and the University of Miami.

Supervisory training is generally handled by the personnel section of the company in foreman seminars, management training courses and extension courses in allied fields from nearby schools.

Surprisingly, perhaps, none of the supervisors felt that in-plant training was a vital need. One man remarked that "photography is not a hard field in which to learn basic techniques; look at all the amateurs. It is the skill on the job that really matters and that is something you can only learn by working. Besides, photography is not something you can learn. If you don't have a 'feel' for it, you'll never be much good no matter how many schools you go to or how good they may be."

Diploma is nice; experience better

Perhaps the biggest obstacle to any widespread in-plant training program is just the small number of photo jobs compared with the number of people who have some background in photography. Photographers are not welders; a firm does not need thousands of photo people in a hurry. They can always up-grade a promising beginner and if special talent is needed in a hurry, they can always hire it. It might cost more but it's there when needed.—THE END

Coming! For the First Time!

PMI DIR

THE PMI DIRECTORY will be the only centralized Reference and Buying Guide in existence for the inplant photographer, the reproduction engineer, and the many technical and engineering personnel who apply photo and repro methods in their work. Up until now, information on products, services, materials, etc. has been available—but in a widely scattered form. There were losses both to the man doing the work and to the manufacturer or service supplying the need.

A working tool such as the PMI DIRECTORY has long been asked for in the field. Now, at last, the need and the want will be filled. Under one roof, the PMI DIRECTORY will provide an up-to-date, all-inclusive listing of essential information pertaining to the vast industrial market in all its branches. Equipment . . . Materials . . . Manufacturers . . . Services. Everything will be at the fingertips of the user, assorted and classified. It will be accurate, authentic, reliable – produced as a helpful service by the Editors of PMI magazine.

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The Editors of PMI have been working many months in order to make the PMI DIRECTORY a useful and valuable reference work and buying guide. It will be the only meeting place of its kind for buyer and seller. It will include names and addresses of manufacturers and services . . . trade names . . . product and service listings . . . the famous PMI charts, diagrams, graphs . . . and other helpful information. It will serve as a home or office library for the man on the job, the purchasing agent, the department head, the technical personnel. Here will be a Directory of Who, What, Where . . . a "work-bench" reference with information unavailable in any other single source.

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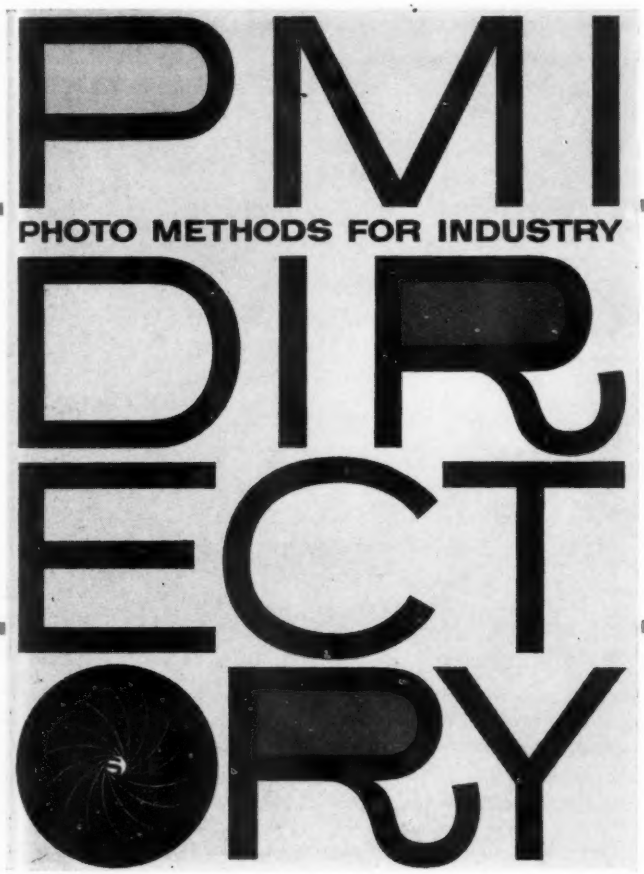
It makes no difference what branch he is in, there will be something helpful and useful in the PMI DIRECTORY for everybody: still photography, motion picture photography, photo instrumentation, reproduction, graphic arts, audio-visual, visual communications in all its phases. This will be the most ambitious ever undertaken in this field, and it marks another successful milestone in the history of PMI, preferred magazine of industry.

PMI DIRECTORY

RECTORY

An accurate, reliable, up-to-date reference and buying guide for the man using photo methods in industry and visual communications!



33 West 60th Street, New York 23, N.Y.

HERE IS A PARTIAL LIST OF CONTENTS:

CAMERAS: 35mm, 70mm, motion picture, aerial, high speed, sequence, microfilm, oscilloscope, Polaroid, underwater and more, more, more.

MOTION PICTURE EQUIPMENT: cameras, processing units, lenses, dollies, editors, tripods — all that's needed for industrial cinematography.

PHOTO INSTRUMENTATION: cameras — high speed, panning, streak; sequence cameras, stop motion projectors—the latest and complete listing of this specialized equipment.

DARKROOM EQUIPMENT AND SUPPLIES: enlargers, chemicals, dryers, processors, sinks, densitometers, washers, everything for color and black-and-white processing.

REPRODUCTION: offset duplicators, presensitized plates, photo lettering machines, process films, chemicals. White Printing: diazo machines, papers, foils, films. Microfilm: cameras, readers, enlargers, printers, reels, cards.

GRAPHIC ARTS: process cameras, sinks, tanks, tables, trimmers, lenses, enlargers.

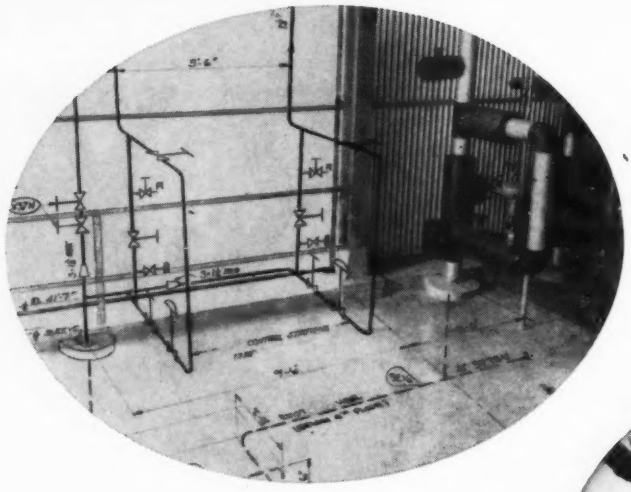
AUDIO-VISUAL EQUIPMENT AND SUPPLIES: sound-silent projectors, strip projectors, 16mm projectors, screens, stands, files, tape recorders, table top projectors.

FILMS: just all of 'em. For press work, commercial, graphic arts, microfilm, aerial, Polaroid, X-ray, etc.

HOW THE PMI DIRECTORY WILL BE DISTRIBUTED

The PMI DIRECTORY will be published in September, 1960. It will be distributed to readers of PMI—Photo Methods For Industry —as part of their subscription. If you are not a PMI subscriber, you can reserve your free copy of the PMI DIRECTORY by using the postpaid order card on page 85.

CRONAFLEX®: best engineering films you can use

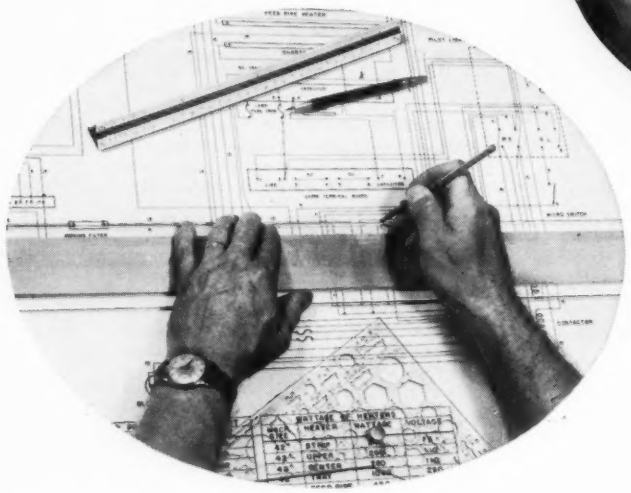


CRONAFLEX: Photographic versatility

CRONAFLEX plus photography plus drafting equals the best combination for photo-drafting techniques.

CRONAFLEX: Durability of CRONAR® base

CRONAFLEX copies are free of kinks and tears. Its rugged and flexible base adds years of life to your drawings.



CRONAFLEX: Superb drafting surface

Matted on both sides, CRONAFLEX accepts pencil and ink, erases easily without ghosting or affecting the surface.

CRONAFLEX Engineering Reproduction Films are now being used to make outstanding reproductions of engineering drawings in shops everywhere. Shown here are three major reasons that help explain its success. There are more.

ALL CRONAFLEX films are on rugged CRONAR* polyester base. This means they are dimensionally stable . . . so stable that many companies use them for exacting template work. CRONAFLEX intermediates provide faster print-through speeds and better resolution of detail because of the optical clarity of the base.

CRONAFLEX films are now available in four types: (1) Direct Positive Film; (2) Contact Film; (3) Projection Film; (4) CRONAFLEX Drafting Films. It's the most complete versatile line of engineering reproduction films you can use. For more information, contact your Du Pont Technical Representative, or write: E. I. du Pont de Nemours & Co. (Inc.), Photo Products Department, Wilmington 98, Delaware. In Canada: Du Pont of Canada Limited, Toronto.

* Du Pont's trademark for its polyester photographic film base.

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OFFSETTING WORLD TENSIONS

Brevity may be the soul of wit but diplomacy requires words, words, words, all recorded and printed by the UN Reproduction Section on a three shift, 24-hour, 1,000,000-page units a day basis

Some observers of the current scene take the position that if the United Nations did nothing else, its cost to the world would be more than repaid by the opportunity it offers potential combatants to strafe each other with words in parliamentary and committee debates, thus furnishing a safety valve that prevents the planet from bursting into warfare. Philosophical considerations aside, the UN does produce a river of words, most of which are faithfully recorded, translated, microfilmed, photocopied, reproduced and delivered in neat 8½ x 11 sheets to the desks of the speakers before the next day's go 'round, ready, one assumes, to be carefully read and digested as an aid to weighty deliberation. It is no small matter. Internal publications of the UN often amount to a million pages daily of short-run documentary material.

Although the responsibility of meeting these demands is in the hands of Rene Lavigne, Chief of the UN's Publishing Service, the actual reproduction process is supervised by Gaston A. Moucheraud, head of the Reproduction Section, a 24-hour a day, three-shift, offset system housed at the United Nations Headquarters in New York City.

The Publishing Service with its Reproduction and Printing Sections first went into operation in the early days of the UN—March, 1946, to be exact—and from the beginning the mountains of paperwork at the UN have been reproduced internally. After two moves in the New York metropolitan area, the Reproduction Section transferred in 1951 to their present location in the Secretariat building at the United Nations Plaza in Manhattan on the bank of the East river.

The Publishing Service coordinates the copy which comes from the various committees' editorial departments and sends it to the Reproduction Section. The United Nations also publishes many reports and studies in book form which are for sale to the general public. The handling of this operation is supervised by Mr. Crouzet-Pascal of the Printing Section. These books are generally printed externally but may be printed internally on the Reproduction Section's offset presses during slack periods.

The main function of the Reproduction Section however is to publish the daily *Journal* of the UN and to supply the various delegates in session with accurate, legible copies of transcriptions of all reports, discussions, conferences and official meetings by 9 o'clock the morning after such events occur. The *Journal* is the official publication of the United Nations and performs two functions: first, it acts as a calendar of forthcoming meetings and second it furnishes brief summaries of meetings which occurred on the day previous to publication. The UN publishes the *Journal* and all other official documents daily in the "working languages" of the UN—English and French. During the General Assembly Spanish is also a working language. However, all the documentation for the General Assembly appears also in Russian and Chinese, the other "official" non-working languages.

The Reproduction Section is housed in a second basement level and has a staff which varies in size from 100 to 130. Moucheraud schedules the copy and stencils which come down from the Publishing

REPRODUCTION CHANNELS AT U. N. HEADQUARTERS

One man, above left, microfilms up to 10,000 pages daily on two rolls of 16mm microfilm—one for reproduction section file, other for library. Photostat and diazo machines, above right, reduce or enlarge copy and artwork; make short run copies of drawings.

REPRODUCTION SECTION

Gaston A. Moucheraud
SECTION HEAD

Copy and negative material exposed in contact

Image transferred to aluminum plate via DTR

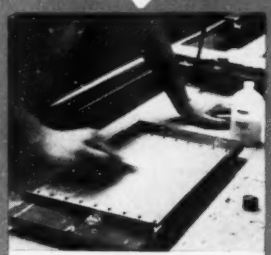
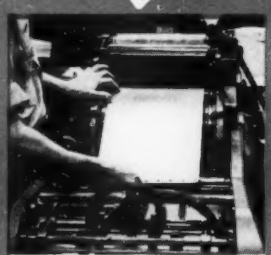


Plate is fixed and lacquered. Jig holds plate

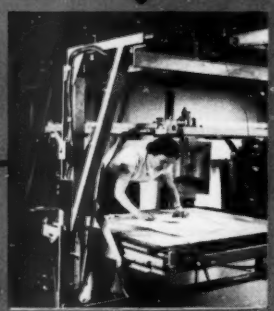


Finished 10 x 15 in. plate is ready for press

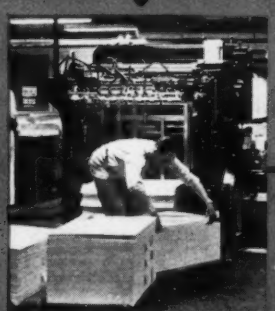
A

B

D



C



E

F

TO DISTRIBUTION SECTION

Main channels through which copy follows at United Nations Reproduction Section. Series at extreme left are diffusion-transfer, direct-contact platemaking process used generally for making copies of official correspondence. 10 x 15-in. aluminum plates are run on one of 3 small offset presses.

Microfilm, photocopy and diazo operations, above, supplement main flow of work starting with cold type composition from edited copy (A); page makeup on light tables. Galleys pasted in desired position (B); pages and other copy placed on vacuum copyboard of overhead type process camera (C). Paper or film negatives stripped on goldenrod flats (D). Negatives are opaqued where necessary and then burned-in on plastic plates 4 or 8-up, for running on one of 5 large offset presses (E). Finished documents are collated and bound in bindery. Here (F) documentary material is saddle stitched and collated automatically. Photostencils (not shown) are either mimeographed or are stripped on flats.

Service's multilingual typewriters on the 15th floor to meet the daily deadlines. Seventy-five to 80 per cent of the daily work load is in the form of a proprietary mimeograph stencil which may be stripped on large flats and exposed on plastic offset plates or which may be put on a mimeograph machine and run off immediately. The choice of method—mimeo or offset—is generally governed by the length of the run required and the work load on the presses. Mr. Muocheraud explained that there is no set rule regarding method and the break even point between the two methods could not be stated arbitrarily.

Fair copy, as the UN defines it, is any material which must be reproduced by means other than this stencil material. It may take the form of typewritten transcripts of conferences, committee reports, official correspondence—or it may be in the form of Chinese calligraphy. The volume of fair copy accounts for approximately 20 per cent of the Reproduction Section's work load. This is handled in one of three ways. 1) Shot with a process camera and negatives used to make offset plates, 2) recomposed with cold typesetting methods and pasted in page form for camera and 3) copied with a recently developed proprietary diffusion-transfer-reversal platemaking process.

On pages which are shot with the process camera exactly as they come down to the section paper negatives are used generally if the highest quality is not required. The camera is of the overhead type, equipped with a 30-in. lens, vacuum back and vacuum copyboard.

Cold composition at the UN is used for the official reports of the various committees and councils that are in session. Edited copy is transcribed by women at a battery of electric transcribers which produce copy in unjustified lines and a coded tape simultaneously. The tape is fed into a reproducer which sets up the type in justified form. The galleys are subsequently cut apart and pasted up in page form. Many of these pages require a masthead of the particular committee or council and the section simplifies page make-up by using pre-printed masthead pads. These pads are actually repro proofs of the respective mastheads and logotypes; thus only the numerical designation of the session requires resetting daily. After these pages are shot, the negatives are stripped on flats 8-up and burned in on plastic plates. These are run on one of three large 22½ x 35-in. presses. Reports shorter than eight pages are printed 4-up on a 21 x 29-in. press. The section has two presses this size.

Although the section has several plate whirlers for coating zinc plates, most work is on aluminum or plastic pre-sensitized plates.

The diffusion transfer reversal, direct-contact process of making aluminum offset plates is used mostly for reproducing short runs of official correspondence. This equipment is currently on trial but has been successful so far. Indications are that it will become a permanent part of the daily routine. This operation requires a contact printer with vacuum pump and a developing unit which transfers the image to the pre-sensitized aluminum plate. The whole operation permits a finished plate to be made ready for press in less than one minute. Exposures run approximately 15 sec., developing 10-15 sec. and fixing the plate about 20 sec. The plates are lacquered at the UN for longer plate life although this step is not absolutely necessary, according to the manufacturer. Cost of each plate is 39¢. Press runs of these aluminum plates with 8½ x 13-in. printing area average 200 to 2000 however, and one plate was used for a run of 5000 copies a day for five days before it showed signs of breaking down.

The bind that ties

Once stacks of printed matter come off the presses or mimeo machines they are pushed on trucks to the bindery which adjoins the press room area. The bindery is equipped with folders, collators and binders capable of handling up to 96 pages at a time. There is even a covering machine to handle soft cover books printed by offset, during slack periods in the Reproduction Section. Bound documents are given finally to the Distribution Section which funnels the material out to the proper delegations.

Other reproduction equipment

In addition to the offset and mimeograph operation the section has supplementary reproduction equipment—diazo, photocopy and microfilm machines. The diazo unit is used to reproduce architectural drawings, plans and other illustrative material of which very short runs are required. The photocopy machine is used to enlarge or reduce type and illustrations for paste-ups. The microfilm machine is used to record all printed matter that comes out of the section. By means of multiple lenses, the camera simul- (*continued on page 67*)

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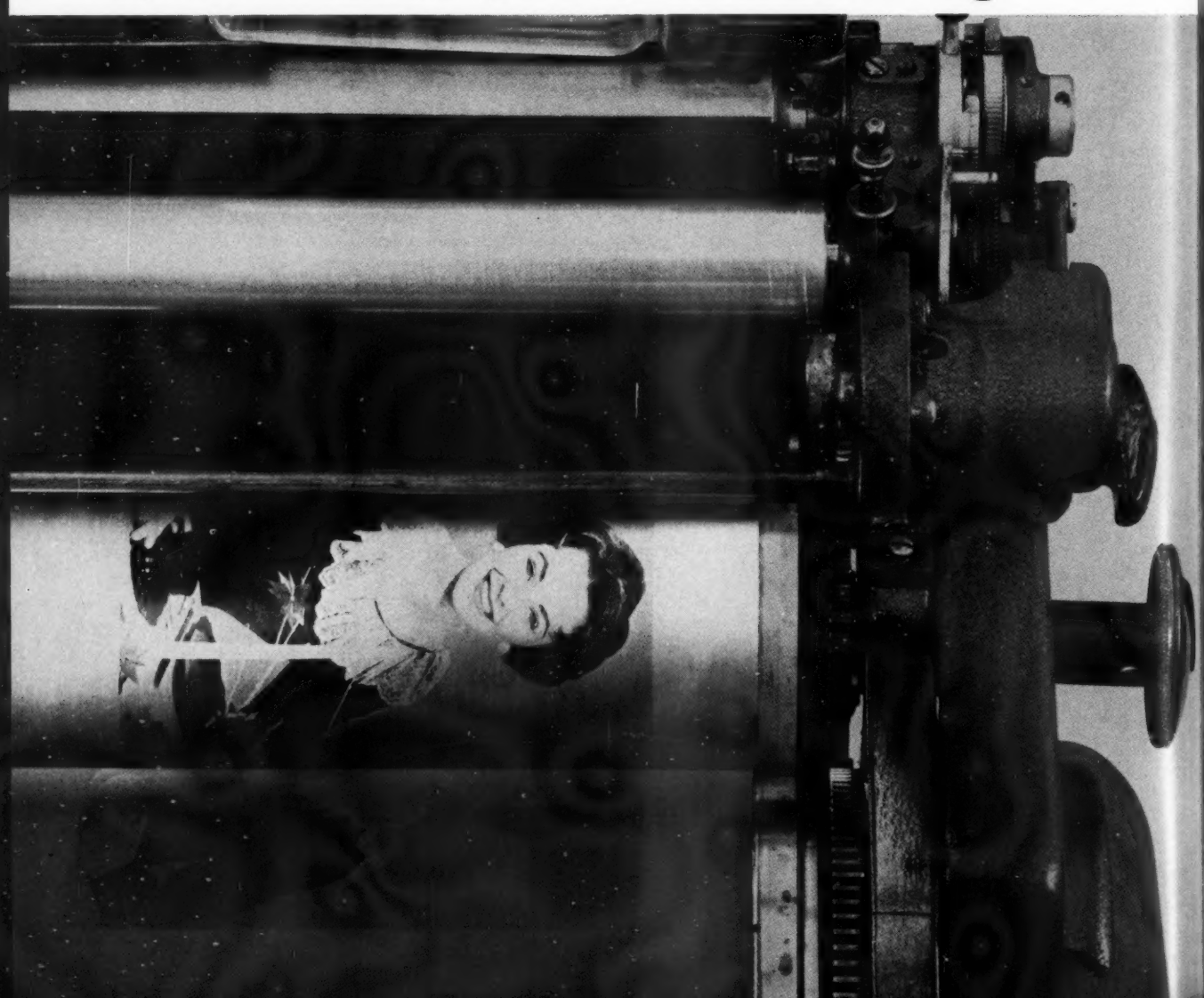

PMI IN-PLANT REPRODUCTION

Herbert P. Paschel

GRAPHIC ARTS

Rosy rings pose difficulties for repro man. Paschel outlines cure

In contact printing, and in enlarging too, film or paper prints often exhibit circular or irregular blemishes in the form of concentric alternate light and dark bands. (With line and halftone images however, the typical concentric pattern may not always be as discernible as with continuous tone images.) Such blemishes in prints and films are a photographic record of interference bands and are called Newton's rings after their discoverer, Sir Isaac himself.

According to the wave theory, light is a succession of troughs and crests which represent the maxima and minima of the electromagnetic force. If a beam of light is divided in two, and if the separate beams are reunited at a later stage of their travel, the manner in which the troughs and crests combine assumes importance. When trough merges with trough and crest with crest, the effect is one of reinforcement of energy. But when the phase difference is such that trough merges with crest, cancellation of energy takes place and the light is extinguished. This is known as interference. The colors seen in otherwise colorless objects because of interference effects are due to the extinguishing of certain wavelengths from the incident white light, and the color of the light reflected from such an object is thus complementary to the extinguished wavelengths.

At any interface between two media as, for example, the glass of a printing frame and the film, light is partly reflected and partly transmitted. When two such surfaces are only in partial contact the separation varies and the multiple reflections that result vary in the distance traveled. Certain wavelengths are thrown out of phase in respect to others. Where the separation at a particular place is of the right thickness to "interfere" with a certain wavelength, the light will be extinguished.

This simplified explanation of the principle of interference fails to take into account all of the complications that exist when Newton's rings are formed. It does, however, indicate the nature of the problem and suffices for the purposes of this article.

Where they lurk

In contact printing Newton's rings are more likely to occur at the interface of the film or plate and the contact frame glass; in enlargers, be-

(*continued on page* 64)

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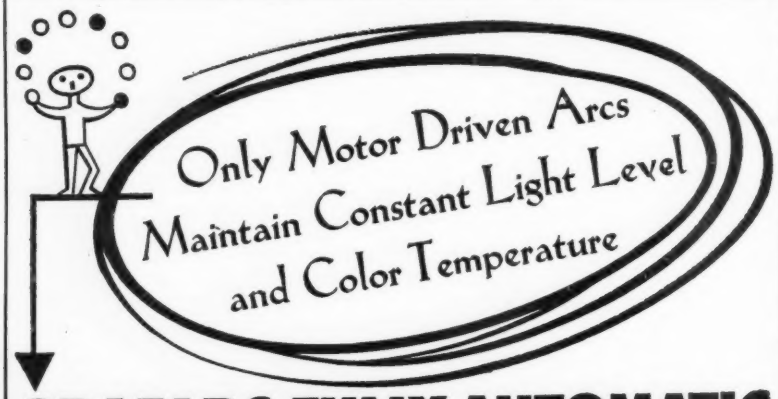

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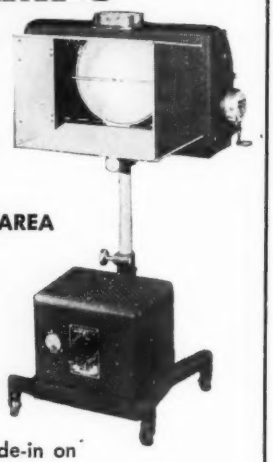

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(*continued from page* 63)

tween the negative and the carrier cover glass. But they may also appear, though to a lesser extent, at other interfaces in a sandwich of photographic material.

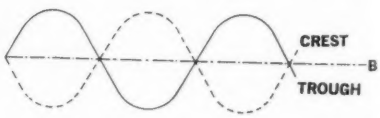
Before discussing how to eliminate Newton's rings it might be advisable to introduce a word of caution. All blemishes not attributable to corresponding defects in the negatives are not necessarily due to interference patterns. Certain mottled effects are caused by localized areas out-of-contact due to grit, other foreign matter on the film surfaces, or a kink in the film. (The foregoing, however, could likewise introduce the separation that gives rise to interference patterns.) The first step, therefore, is to evaluate the blemishes carefully to determine whether or not they are mottling or Newton's rings.

When the evidence points overwhelmingly to Newton's rings a number of corrective measures may be taken singly, or in combination.

The following are corrective measures that may be tried in connection with the contacting surfaces.

1. With vacuum printing frames Newton's rings may often be eliminated by the simple expedient of varying the degree of vacuum. This is possible with most vacuum frames by adjusting the opening of the relief or by-pass valve. The procedure is to reduce pressure gradually until the rings dissappear without, however, going so low that overall out-of-contact results.
2. Coating the offending surfaces with a thin film of oil or wax, often introduces enough additional separation or otherwise disturbs the multiple reflections to eliminate interference.

Interference of Light: **A** Two light waves of the same frequency (wavelength) proceeding in phase reinforce one another. **B** The same two light waves proceeding out of phase so that maxima (crest) coincides exactly with minima (trough) result in annulment of the light.

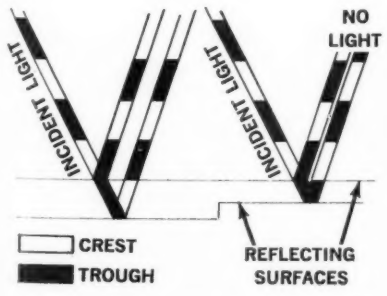


3. Dusting the contacting surfaces with "offset spray" powder.
4. Inserting a thin sheet of cellophane between the suspect surfaces. (If this is between negative and sensitive material a slight loss in sharpness must be anticipated.)

The remaining alternatives all deal with diffusing the exposing light since, in most cases, Newton's rings are more prevalent with highly collimated light.

1. Diffusing the light at the source.
2. Using ground glass in the printing frame instead of clear glass.
3. The above may be accomplished temporarily by attaching a matte surface plastic to the clear glass of the printing frame.
4. Interposing a sheet of matte plastic between the frame glass and the material to be exposed.
5. With overhead exposing lights suspended on wires or chains, having the light in motion (swinging) during exposure introduces a certain amount of diffusion.
6. Decreasing the distance between light and frame changes the incident angle of the light and often helps.

This brief summary presupposes that no basic equipment defects contribute to the problem. This may be the case when Newton's rings are a consistent problem that does not readily respond to the treatment outlined. Two possibilities that come to mind are defects in the vacuum frame glass and a stiff rubber blanket. The latter may prevent complete and uniform evacuation of the air resulting in air pockets. Such a condition favors Newton's rings. A leak at the bead of the blanket may likewise promote the differential contact that gives rise to interference patterns. In either case the blanket should be replaced for a permanent solution.—THE END



A simplified schematic of how Newton's rings are formed. When the separation between the reflecting surfaces is such that the merging reflected beams are out of phase the light is extinguished. In contact printing the situation is far more complex since secondary reflections and transmitted beams are also involved.

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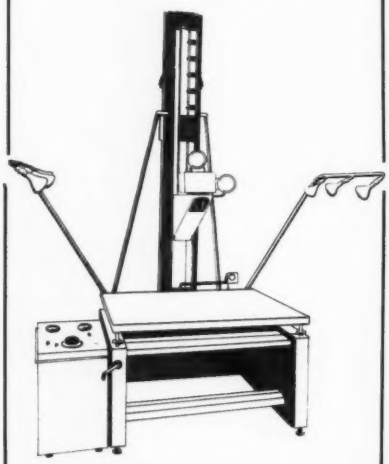

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MICROREPRODUCTION

(*continued from page 44*)

netically recorded tapes containing micro-documentary images? The implications of electrostatic reproduction developments as well as the economics of high reduction, in the magnitude of 100 diameters, reduction will be discussed. Similarly the uses of non-conventional materials and the retrieval of microreproductions by high speed devices are scheduled for attention.

NMA award

An important part of the convention is always devoted to regular Association business including the Annual Business Meeting, the election of new officers, committee meetings and related functions. A special feature, of particular interest this year will be the presentation to a recipient selected by the Awards Committee of the NMA award for "Meritorious Service to the Microreproduction Industry."

NMA Conventions enjoy an enviable reputation as "working" meetings that are serious, purposeful and rewarding. They are all of these but there is always time for informal gatherings, meetings and conversation. The unique opportunity to meet with old or new friends for the discussion of matters of mutual professional interest is well worth while.

NMA Officers for 1959-60

PRESIDENT: Joseph F. Curtin, Graphic Microfilm of New England, Waltham, Mass.
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PUBLICITY: C. Peter McColough, Haloid Xerox, Rochester, N. Y.
AWARDS: R. A. Boylan, The Microfilm Corporation, Cleveland, Ohio.

As in past years, the directors and membership of NMA extend a cordial invitation to all who are interested in the field of microdocumentary reproduction to attend and participate in the convention. Complete details may be secured from any of the above listed officers or Convention Chairmen or from the Executive Secretary of NMA, P.O. Box 386, Annapolis, Md.—THE END.

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UN REPRODUCTION

(*continued from page* 61)

taneously makes two 16mm copies of each of the documents. One roll is retained in the Reproduction Section's file as a ready source for prints, which can be used to make offset masters. The other roll goes to the United Nations Library where it is available to qualified personnel for use on microfilm reader-printers.

An additional job of the Reproduction Section is servicing office copying and spirit duplicators located in many of the UN offices.

International staff

Reproduction Section employees are as international in origin and interests as the UN itself. In fact workers in the professional job classifications are required to be bilingual, and many are multilingual. A job rating system much like Civil Service classifications is used for non-diplomatic personnel. In the Reproduction Section, turnover is very low and salaries are comparable with similar work in private industry in the area. Although there is no labor organization, wages for pressmen and other mechanics and technicians are equal to or higher than those paid by local union shops, where many of the staff gained their proficiency. For example, the current local union contract provides for three weeks vacation while the UN provides six.

Moucheraud stated that at the present time a training program has been started and new workers as well as the present staff are given on the job training in the techniques of the section.

Presses run

A sidelight to the operation of the Reproduction Section is that it is ready to follow UN proceedings throughout the world. Last year members of the staff packed small presses, mimeographs, stencils and other paraphernalia to UN meetings in South America and Pakistan, and traveled as well to Geneva, Switzerland. The Geneva site is fully equipped and even does composition in Russian (only stencils are made in Russian in New York), but is augmented by UN headquarters' personnel during peak periods. In every case the Reproduction Section shoulders the responsibility for quick, accurate and competent document reproduction required by the very special world of international diplomacy. Members of Moucheraud's staff will travel to the very ends of the earth if official UN delegations meet there.—THE END

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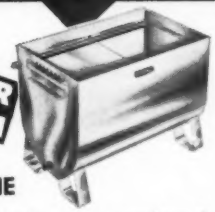

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CRT RECORDING

WITH POLAROID LAND MATERIALS

Oscilloscope trace recording with picture-in-a-minute materials is reviewed here by Kemon P. Taschioglou, Polaroid Corp., Cambridge, Mass., and Hy P. Mansberg, Airborne Instruments Laboratory, Mineola, N.Y. This article, which originally appeared as a three part series in Electronic Design Magazine, *treats camera and oscilloscope equipment, films and techniques.*

At the time of this writing, eight manufacturers produce specialized cameras for cathode ray oscilloscope (CRO) trace recording utilizing Polaroid Land camera backs. The cameras mount directly onto the standard CRO 5-in. tube face and are designed to solve the problems of low light level, close-up photography imposed by the cathode ray tube (CRT) trace. They provide accurate centering, maintain focus and control stray light.

Basic considerations in the design of oscilloscope record cameras are the position of the camera back and the viewing system. Three variations are commonly used: 1) *Film plane parallel to the tube face, with viewing at a slight angle to the tube face.* The major advantage of this system is that the picture is correctly oriented—rather than being reversed. On the other hand, the viewing angle of this system causes slight distortion. 2) *Film plane perpendicular to the tube face, with a beam-splitter mirror to permit head-on viewing.* In the cameras employing this system, a comfortable binocular viewing is provided. The mirror, however, reverses the image on the film. 3) *Film plane parallel to the tube face with a swinging assembly so that the camera back can be swung away from the CRT face.* The Edgerton, Germeshausen, & Grier, Inc., CRO-Camera using this technique employs a traveling-wave CRT designed specifically to display transients and repetitive phenomena in the milli-microsecond region. The trace is displayd on a 0.4 x 0.6-in. area and is viewed through a built-in 5X viewing lens. The other camera using this system, Beattie-Coleman's Model 12365, has binocular angle viewing with the camera back swung into place and direct head-on viewing when the camera is swung away.

The beam splitter mirror found on some cameras separates the highly actinic blue from the less actinic yellow portions of light energy emitted by the CRT. Only a negligible amount of actinic light is lost by sending some yellowish light through the beam splitter to the observer.

Camera backs are mounted with the long film dimension parallel either to the horizontal axis of the CRT or parallel to the vertical axis. The former mounting permits recording full horizontal width trace images from the 5-in. CRT. The latter mounting is combined with optical reduction.

Some cameras have optical systems which reduce the image size on the film by a factor of two. Image reduction has two primary advantages: first, film usage is more economical, because more images can be recorded per frame. And second, there is a gain in the trace brightness reaching the film for a given exposure.

On the other hand, those cameras which make a same size image make calibration directly on the picture much easier.

To take full advantage of the picture area available on each frame, Beattie-Coleman, Du Mont, Fairchild, and Hewlett-Packard have designed cameras which permit multiple exposures. The first three manufacturers provide movable

(*continued on page* 70)

Oscilloscope Record Camera

MANUFACTURER	MODEL NO.	LENS
Beattie-Coleman, Inc. 1000 North Olive St. Anaheim, California	12445	Wollensak Raptar 75 mm. f/1.9
	12365	Wollensak Raptar 75 mm. f/1.9
	M-28	Wollensak Amaton 75 mm. f/2.8
	M-19	Wollensak Amaton 75 mm. f/1.9
	M-19F	Wollensak Oscillo-Raptar 75 mm. f/1.9 flat field
Allen B. Du Mont Laboratories, Inc. 760 Bloomfield Ave. Clifton, New Jersey	302 (f/2.8)	Wollensak Raptar 75 mm. f/2.8
	302 (f/1.9)	Wollensak Raptar 75 mm. f/1.5
	353 (f/2.8)	Wollensak Raptar 75 mm. f/2.8
	353 (f/1.9)	Wollensak Raptar 75 mm. f/1.9
Edgerton, Germeshausen & Grier, Inc. 160 Brookline Ave. Boston 15, Mass.	710 with Type CA-3 Polaroid Adaptor	Effective f/0.7
Electronic Tube Corp. 1200 E. Mermaid Lane Philadelphia, Pa.	SM-200	Wollensak Raptar 75 mm. f/1.9
Fairchild Camera and Instrument Corp. 580 Midland Parkway Yonkers, N. Y.	F-296	Wollensak Raptar 75 mm. f/1.9
	F-286	
Hewlett-Packard Co. 275 Page Mill Road Palo Alto, California	196-A	Wollensak Oscillo-Raptar 75 mm. f/1.9
Telechrome Manufacturing Corporation 28 Ranick Drive Amityville, New York	1521-A	Wollensak Oscillo-Anastigmat f/1.9 75 mm.

Camera with Polaroid Land Camera Backs — Manufacturers and Characteristics — Table I

LENS	SHUTTER	CAMERA BACK POSITION	ORIENTATION OF FILM'S LONG DIMENSION	METHOD OF VIEWING	IMAGE ORIENTATION	REDUCTION RATIO	MULTIPLE EXPOSURES POSSIBLE	OTHER FEATURES
Wollensak Raptar 75 mm. f/1.9	Alphax #3, 1 sec. to 1/100 sec., time and bulb.	Above line of view, perpendicular to CRT	Parallel to CRT Horizontal axis	Binocular, dichroic mirror	Inverted	1:1	Sliding back with either 3 or 10 equally spaced exposures	Mounts on K-5 Periscope Assembly which takes other cameras as well.
Wollensak Raptar 75 mm. f/1.9	Alphax #3, 1 sec. to 1/100 sec., time and bulb.	Parallel to CRT, with swing away assembly	Parallel to CRT Horizontal axis	Binocular, direct view	Normal	1:1	Sliding back with either 3 or 10 equally spaced exposures	
Wollensak Amaton 75 mm. f/2.8	Alphax #2	Parallel to CRT, with swing away assembly	Parallel to CRT Horizontal axis	Binocular, direct view (accessory)	Normal	1:1.9	Nine detent positions for camera back	Many accessories, including 35 mm streak adaptation, data clock and chambers.
Wollensak Amaton 75 mm. f/1.9	Alphax #3							
Wollensak Oscillo-Raptar 75 mm. f/1.9 flat field	Alphax #3							
Wollensak Raptar 75 mm. f/2.8	Alphax #2, 1/25 to 1/100 sec. and bulb.	Above line of view, perpendicular to CRT	Parallel to CRT Vertical axis	Binocular, dichroic mirror	Inverted	2.25:1	Sliding back with 3 position detent and scale markings for 9 exposures	Data card recording possible. Two full screen images can be recorded per frame. Accessories for mounting either types of camera backs and film available.
Wollensak Raptar 75 mm. f/1.5	Alphax #3, 1 sec. to 1/100 sec. and bulb.							
Wollensak Raptar 75 mm. f/2.8	Alphax #2, 1/25 to 1/100 sec. and bulb.	Parallel to CRT	Camera can be rotated 90° for recording on both axes of film	Monocular, direct view peep hole	Normal	1:1	Sliding back with 3 position detent and scale markings for 9 exposures	Minification adjustable to accommodate full 5-inch sweeps. Interchangeable camera back.
Wollensak Raptar 75 mm. f/1.9	Alphax #3, 1 sec. to 1/100 sec. and bulb.							
Effective f/0.7	Manual movement of dark slide.	Parallel to CRT, with swing away assembly	Parallel to CRT Vertical axis	Separate Monocular Camera must be swung out of position. Enlarging viewing lens provided.	Normal	1:1	None	Designed for use with E. G. & G.'s travelling wave oscilloscope for recording extremely short pulses to 4 millimicroseconds.
Wollensak Raptar 75 mm. f/1.9	Alphax #3, 1 sec. to 1/100 sec., time and bulb.	Parallel to CRT	Parallel to CRT Vertical axis	Monocular, direct view peep hole	Normal	1:1	None	
Wollensak Raptar 75 mm. f/1.9	Alphax #3, 1 sec. to 1/100 sec., time and bulb.	Parallel to CRT	Parallel to CRT Vertical axis	Monocular, direct view peep hole	Normal	1:1	None	
						2:1	Back can be positioned in two places	
Wollensak Oscillo-Raptar 75 mm. f/1.9	Alphax #3, 1 sec. to 1/100 sec. time and bulb.	Parallel to CRT	Parallel to CRT Horizontal axis	Binocular, direct view	Normal	1:0.9	Lens movable to provide full width exposures	Camera back rigid. Two 6CM X 10CM grid scales can be recorded on one frame. Focussing accessory kit is available.
Wollensak Oscillo-Anastigmat f/1.9 75 mm.	Alphax #3, 1 sec. to 1/100 sec. time and bulb.	Parallel to CRT	Parallel to CRT Vertical axis	Monocular, direct view peep hole	Normal	1:1	None	

camera backs. The Hewlett-Packard camera offers the same effect with a movable lens mount.

Mounting and operation

All the cameras listed mount securely either to a flange provided on standard 5-in. CRO's or to a standard bezel which can be easily attached to the CRO. Although the CRO cameras are basically fixed focus, slight changes are provided to overcome variations in the exact position of the CRT face. Such variations arise from different CRT face configurations, different CRT positions in the CRO, and the position of filters and graticules. Precise focusing is important to record detail in a trace. A sheet of ground glass in the back of an empty camera provides means for focusing. However, judgment must be used. The trace itself, lacking sharpness, is difficult to focus upon, whereas the graticule scale is not precisely in the same plane as the trace. Cameras of 1:1 reduction ratio require more precise focussing than those with 2:1 reduction ratio because of the decreased depth of field.

Settings for aperture and shutter speed are performed at the lens of the cameras, usually through trap doors, which must be closed during exposure. The camera of Electronic Tube Corporation is an exception. It provides a system for making settings outside the camera. Some cameras require removal of the entire camera from the CRO to make changes.

All the cameras, except the specialized Edgerton, Germeshausen, and Grier camera, employ a lens-shutter combination with 50 or 75mm Wollensak lenses. The low light levels of high-speed transients usually require wide open apertures of f/1.9 and f/2.8. The Hewlett-Packard camera utilizes a Wollensak lens with additional field correction and edge resolution.

The CRO

In selecting a CRO for photographic trace recording, of course, choose one whose circuitry and design features produce the best trace for your purpose. But, other circuitry and design features being equal, here are the two most important features affecting CRO photography:

1) *Accelerating potential* CRO's with higher accelerating potentials produce greater beam current, giving more actinic light output. This

CRT PHOSPHORS' CHARACTERISTICS FOR RECORDING WITH POLAROID LAND FILMS — TABLE II

DESIG-NATION	COLOR		PERSISTENCE	APPLICATION	USE OF FILTERS	COMMENTS REGARDING THE USE OF POLAROID LAND FILMS
	INITIAL FLUORESCENCE	AFTER GLOW				
P-1	Green	Green	Medium	General purpose CRO work, repetitive or transient waveforms. Most frequently used on low voltage oscilloscopes.	None	Relatively efficient for photographic recording of stationary or repetitive patterns. Brilliant output at low accelerating voltages.
P-2	Blue-Green	Yellow-Green	Long	General purpose higher accelerating potentials.	Dark blue filter can eliminate long persistent yellow component for photography. Amber filter can eliminate initial blue-green flash. Remove for photo-recording.	Blue component is short persistent and has high photographic efficiency. Records successive transient phenomena, and low rate repetitive traces.
P-5	Blue-Violet	Blue-Violet	Very Short	Display of high speed transients such as Radar A-Scope.	None	Relatively efficient for single frame recording. Not as high actinic output as P-11 phosphor.
P-7	Blue-White	Yellow	One Short One Long	Similar to P-2, operates at lower accelerating potentials with longer persistence. Useful for radar, low speed transients, and integrating repetitive phenomena.	Blue filter can eliminate long persistent yellow component; necessary for long sweep periods. Amber filter can eliminate initial blue flash. Filters not usually used in photo-recording.	Relatively high photographic efficiency for single frame recording. Not as efficient as P-2 phosphor.
P-11	Blue	Blue	Short	Photographic recording of transient phenomena. Has longer persistence than P-5.	None	Highest photographic efficiency makes it most useful for recording both transients and repetitive traces.
P-15	Blue-Green	Blue-Green	Extremely Short	Flying spot scanners, TV kinescope recording.	None	Not as high actinic output as P-11, but can be used effectively with Polaroid Land Films for high resolution, high frequency recording.

POLAROID LAND FILMS TYPICAL MAXIMUM WRITING RATES* — TABLE III

POLAROID LAND FILM TYPE	ASA EXPOSURE INDEX DAYLIGHT (Equivalent)	MAX. WRITING RATE—NORMAL (cm. per microsecond)	MAX. WRITING RATE—PREFOGGED (cm. per microsecond)	PREFOGGING EXPOSURE WITH 30 CANDLES/FT.² ILLUMINATION	OSCILLOSCOPE TRACE RECORDING APPLICATION	REMARKS
TYPE 42 Paper print 3¼ x 4¼	200	400	700	1/100 sec. at f/8.	Stationary traces.	Most economical of all films, but limited to steady-state trace recording.
TYPE 46, 46-L Positive transparency 2¼ x 2¼/3¼ x 4	600	490	1000	1/100 sec. at f/11.	Slides for projection, recording fine detail in complex waveforms simultaneous recording of slow and fast moving trace portions. Camera mirror inversion easily corrected by turning transparency over.	Originals for diazotype reproduction in reports. Can be easily enlarged by conventional photography.
TYPE 47 Paper print 3¼ x 4¼ Figures extrapolated from results made with smaller aperture than f/1.9. See text.	3000	(over) 3500	(over) 8500	1/100 sec. at f/16.	High Speed transients and stationary traces.	Fastest Polaroid material for CRO trace recording.

* *Maximum writing rate measurements made on Tektronix 517A CRO, 24 KV accelerating potential. Displayed was single 450 MC damped sine wave transient. Camera reduction ratio 1:1 at f/1.9.*

is particularly important when recording high-speed transients. Wide band CRO's in excess of 3 KV are usually needed, both to see, as well as record, fast-moving transients. As a guide, you can assume that the amount of actinic light available under given signal conditions varies roughly with the accelerating potential.

2) *Tube phosphor* Polaroid Land films are recommended for recording with all of the commonly used CRT phosphors such as the P-1, P-2, P-5, P-7, P-11, and P-15. Some are more effective than others in photo recording. Some of these phosphors are used with filters for observation and for photo recording. Some have two color outputs, an initial emission resulting from the direct flash of the electron beam and the persistent afterglow which remains after the beam has passed.

CRO settings and the signal

The *intensity* setting on the CRO controls the beam current and, thus, can have the greatest effect on proper photographic exposure. Slight changes in intensity settings, almost unnoticeable to the eye, can have the same effect as the change of one or two "stops" in camera settings. However, the operator is served by film latitude because good exposures are obtained within a wide range of intensity settings. It has not been practical to build CRO's with calibrated intensity settings to help select exposures. Furthermore, any charts or guides selecting the best intensity setting can be only approximate.

Spot size CRO's which produce smaller and more uniform spot size over the entire screen area best for obtaining good resolution and detail. Those with higher accelerating potential generally produce a smaller spot diameter, but usually at some sacrifice in the viewing area covered by the entire trace. Naturally, the focus and astigmatism controls of the CRO should be set for the best spot size and uniformity at any particular intensity setting. However, it is sometimes beneficial to deliberately misadjust the astigmatism controls in order to achieve optimum focus in one coordinate of spot motion. For example, to record a very fast rise time on a square wave pulse, one can misadjust the astigmatism control to favor focus on the vertical position, sacrificing focus on the flat-top portion.

Spot speed The exposure produced by the spot varies inversely as the spot speed. As the speed of the spot increases, more exposure or higher intensity are required to produce a good picture—important to keep in mind when recording nonrepetitive traces and the faster portions of repetitive traces.

When recording traces with peaks, remember that the spot speed decreases near the peaks. Consider that portion of the trace which you are interested in recording in selecting proper exposure. Notice in Figure 1 that the

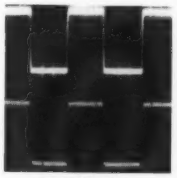

FIGURE 1

FIGURE 2

lower trace was deliberately underexposed to increase detail in the flat top portion of the trace.

Similarly, increasing the amplitude of either axis will increase the spot speed and lower the brightness of the trace. A trace four inches from peak to peak may require four times as much exposure as one which is one inch high.

Frequency and sweep repetition

(*continued on page 73*)

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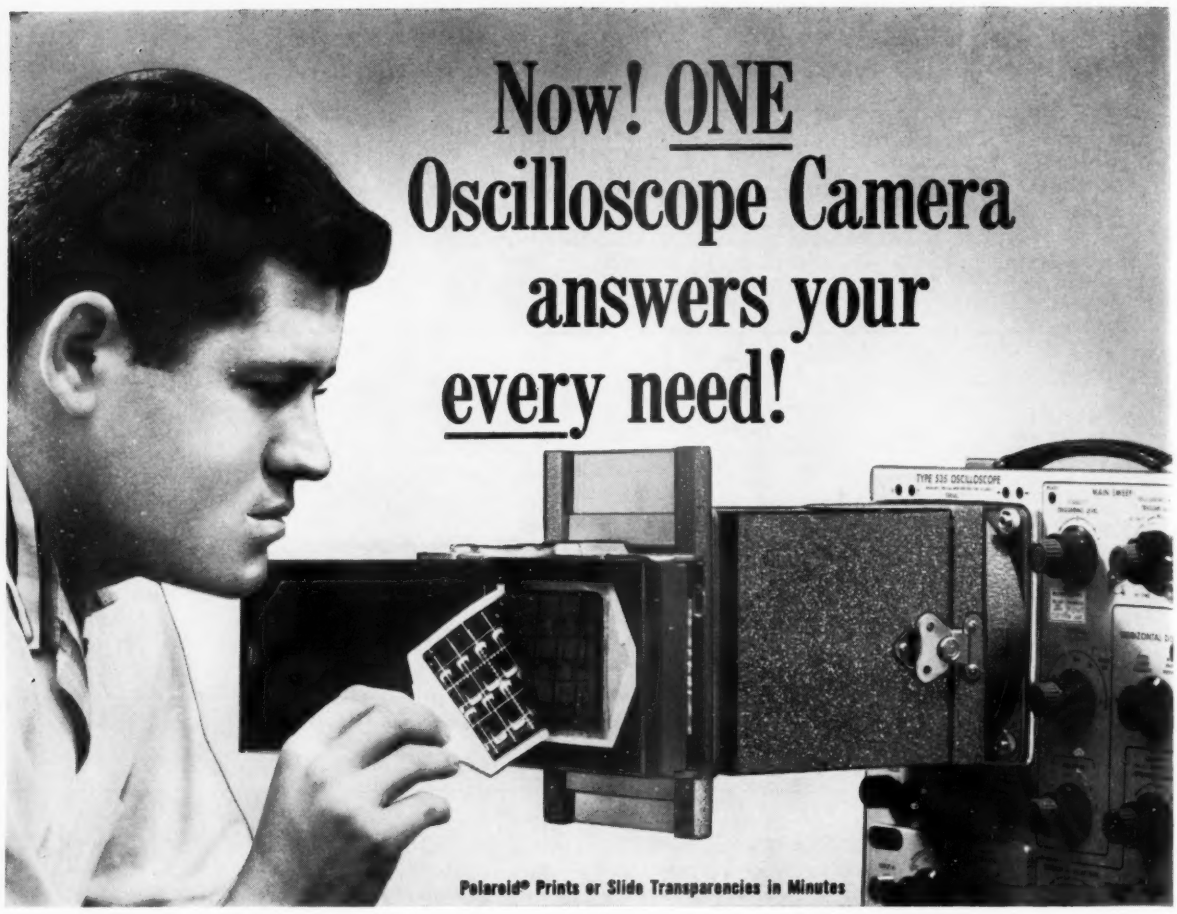

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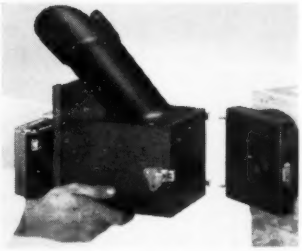

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Get more information. Circle 410, page 91

CRT RECORDING (*continued*)

rates Changing the frequency or sweep repetition rate of a given signal affects exposure, but not drastically, as long as a high-duty cycle sweep is used. For example, in Figure 2, the intensity of the 30 KC trace was kept constant, and the sweep repetition rate was increased from a position indicating 16 cycles per inch on the screen to 1/16 cycle per inch. All traces are readable, yet they could be improved by compensating changes in exposure.

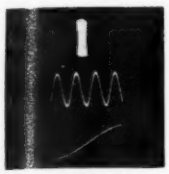


FIGURE 3

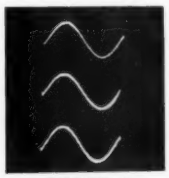


FIGURE 4

Figure 3 shows the effect of changing x-gain to compress the pattern. All traces are made at the same exposure and beam intensity.

Increasing the frequency and changing the sweep repetition rate to produce the same number of cycles on the screen would have no effect on the exposure—again, as long as a high duty cycle sweep is used. In Figure 4, there is no noticeable change in exposure of the 30 KC, 100 KC, and 3 MC traces—intensity and x-gain controls were held constant.

Occasionally, a high frequency signal has to be displayed on the CRO with a very low duty cycle sweep, rendering the signal practically invisible to the eye. The maximum exposure with high-speed Type 47 film often record a low duty cycle trace.

Precise selection of shutter speed setting becomes important in recording continously varying traces, signals with a slow modulation or jitter, and signals requiring

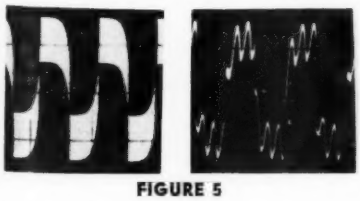


FIGURE 5

very low sweep repetition rate. In Figure 5, for example, modulated signal was clearly defined in the picture by shortening the time setting from ½ sec. to 1/50 sec.

When very low sweep repetition rates are used, the camera shutter must remain open for at least the time of one sweep, or else an undesired blank space may occur in the recording—for example, if the sweep duration is 1/25 sec., and the shutter is 1/100 sec. Even

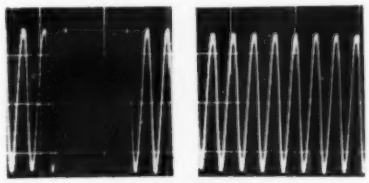


FIGURE 6

if the shutter is open slightly longer than the sweep duration, uneven exposure of the trace may result, as shown in Figure 6. As a general rule, the exposure time should be a minimum of five to ten times the sweep duration to result in a uniform recording.

Recording stationary traces

The techniques of recording stationary patterns is a straightforward one. If the trace can be seen, it can be photographed. Actually, with Type 47 film, you can photograph more than your eye can see. Here are some general rules to keep in mind:

1) Make the settings on the CRO to provide the sharpest trace and most comfortable viewing that brings out the details you are most interested in recording. The camera will record it as your eye sees it.

2) Whenever possible, keep apertures small—down to f/5.6 or f/8—to increase depth of field, improving apparent camera focus, and to reduce optical abberrations.

3) When using low sweep repetition rates, make sure that shutter speed setting is at least low enough to record a single full sweep and preferably 5 to 10 sweeps if no jitter of drift is apparent.

4) Try to keep time exposures at a minimum to reduce any fogging or blurring caused by drift or undesirable modulation.

Exposure guide Obviously it is impractical to determine precisely the combined effect of intensity settings, spot speed, spot size, etc. In general, the choice of best exposure values at first have to be determined by trial and error, but it very soon becomes almost intuitive.

As a rough guide for the person making his first exposures with picture in a minute CRO cameras, here is a table that can be used as a starting point: Type 42 film—f/8 at 1/5 sec.; Types 46, 46L film—f/8 at 1/10 sec.; Type 47 film—f/8 at 1/50 sec. Assume here that you are recording a 50 KC trace with four cycles on a P-11 phosphor. Intensity is set at a comfortable level for viewing with a CRO of 3KV accelerating potential. Camera reduction ratio is 2:1.

Camera settings of two stops either side of the above would, of course, give acceptable pictures.

Recording transients

Basically, the same considerations apply in recording transients as in recording stationary patterns. Exposure is controlled by varying the aperture, for the shutter is usually held open to record one complete sweep. With a non-repetitive transient (whether controlled or random) there is no choice but to leave the shutter open until the transient occurs.

In general, the spot is positioned in the left side of the screen, the camera shutter is held open with the "B" or "T" setting, the transient initiated, and the shutter is closed. With CRO's having automatic beam gate circuitry, the intensity control is usually turned down so that the spot is invisible, to avoid fogging the film while waiting for the transient. When a transient is initiated, the beam is automatically gated, brightening the trace at the same time the sweep is triggered. Because available light from the trace is usually at a premium, trial exposures should be made with the lens aperture wide open. But, of course, intensity and apertures have to be adjusted for best exposures as in re-

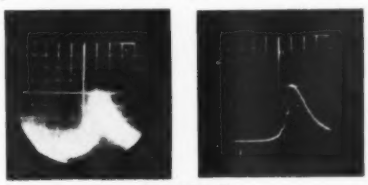


FIGURE 7

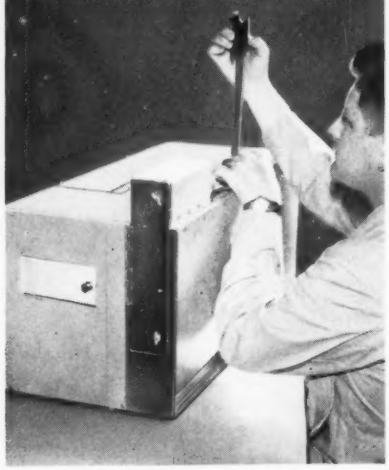
cording stationary patterns. Figure 7, illustrates exposure correction by turning density down in recording of a transient.

The films

Any Polaroid Land films will usually record simple transients below the 100 KC range. For higher speed transients, Type 47 film should be used. In general Type 47

(*continued on* page 77)

FAIRCHILD MINI-RAPID PROCESSORS



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by Ernest E. Reshovsky

PHOTO INSTRUMENTATION

Atom age photography: the effect of radiation on our camera films

The effect of radiation on the photographic emulsion is a subject currently very much on the mind of many experts in the field.

Already now, and even more so in the future, cameramen, or unmanned cameras, are entering areas where radiation hazards in the form of gamma-rays, x-rays, radioactive isotopes, etc. adversely affect the performance of photographic films.

All photographic films are sensitive to radiation to some extent. Generally speaking, films which are highly sensitive to visible light tend also to be highly sensitive to non-visible short-wave-length radiation, although not necessarily in the same relationship.

Therefore it is impossible to predict the speed of a certain film to penetrating radiation merely from the knowledge of its visible light speed.

We discussed the subject with Mr. S. Phillips of Eastman Kodak Co. and with the people at Ansco's Physics Laboratory, working under Dr. F. W. H. Mueller, Director of Research.

Both companies are doing considerable research into the problems of radiation effects.

Phillips explained that most research is done by the use of hard radiation at 1000 kvp. He reported: "Our experience, and that of other workers, indicates that the sensitivity of a particular photographic material is essentially the same for all radiation harder than that generated at 1000 kvp. Thus, the sensitivity of a film to 1000 kvp x-rays will represent fairly well its sensitivity to the gamma-rays of radium or cobalt-60, for example. The graininess of the silver image resulting from gamma-ray exposure is greater than that resulting from light source exposure. Therefore the graininess will increase appreciably for most films with increased gamma-ray pre-fogging. It may be that in some applications, this factor will put a lower limit to the permissible gamma-ray exposure than will the distortion of the characteristic curve."

Ansco's Physics Laboratory stated that prolonged exposure to high energy radiation will cause undesirable fog, reduced contrast and restriction of the recordable subject brightness range in negative materials. In the

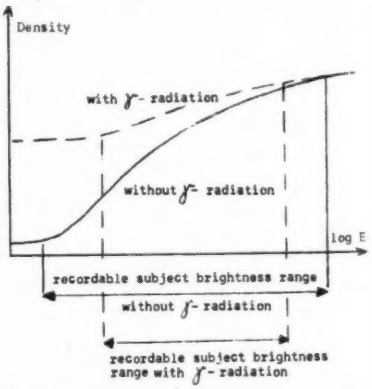

FIG. 1 Effect of high-energy radiation on a high-speed negative film: Increased fog, reduced contrast and effective speed, and restricted recordable subject brightness range. Courtesy of Ansco

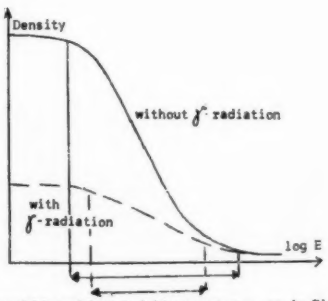

FIG. 2 Effect of high-energy radiation on a reversal film (black-and-white or color): Reduced maximum density, reduced contrast and reduced maximum density, which in the case of color film, result in a loss of saturation. Courtesy of Ansco

case of reversal materials (e.g. color) there will be a decrease of contrast, maximum density and recordable subject brightness range.

Radiation sensitivity also increases if the energy of the radiation decreases: it is about 20 times higher for x-rays, as used in medicine; i.e. only 1/20 of the dosage causes the same detrimental effects on photographic emulsions as high-energy gamma radiation. But it is relatively easy to protect photographic material against low-energy radiation by suitable metal shielding which is not effective against high-energy radiation. Photographic films can also be protected against all nuclear radiation (electrons, protons,), irrespective of their energy. Film scnsitivity toward neutrons can be neglected for all practical purposes.

Therefore the main concern is to prevent the exposure of high-speed photographic films (black-and-white and color) to dosages exceeding one roentgen of high-energy gamma radiation, against which the film cannot be protected under normal circumstances.

Ansco also found that color film transpariencies exposed additionally to uniform high-energy radiation suffer from desaturated color reproduction due to a reduction of contrast and maximum density. This can only partly be counteracted by changing the processing conditions. It is worth mentioning in this connection that the dose rate, i.e. the time of exposure for a given total dosage, is immaterial. This is contrary to exposure to light where the same total exposure is photographically less effective if it is applied as a low-intensity exposure over a prolonged exposure time.—THE END

THREE identical aerial shots indicate the effect of gamma ray fogging. The top picture, printed on No. 3 glossy paper received no radiation. The bottom two, both printed on No. 5 glossy paper received 8 roentgens, and 32 roentgens, respectively. Courtesy of the Eastman Kodak Company

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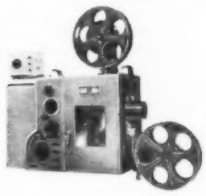

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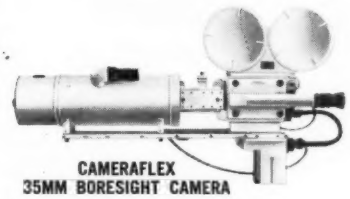

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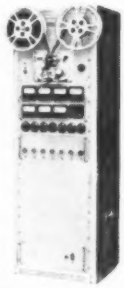

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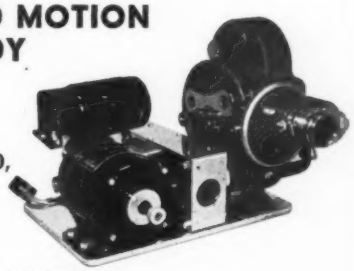

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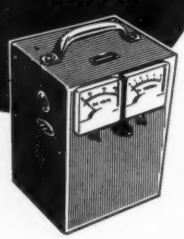

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SWITCH IN TIME

(*continued from page 47*)

be conveniently available to each employee in the department. During 1954, the Renewal Parts Department was converted to microfilm reference. Positive 35mm film of our drawings was cut into individual frames and filed in envelopes, each individually marked. The pieces of film were placed in transparent plastic holders for viewing. The cut film idea enabled us to maintain the file with the latest revisions. Other reference material, not subject to revision, such as order papers and engineering data are stored on 16mm roll film. We spent a great deal of study on ways to improve this reference file and particularly the 35mm film of drawings. This resulted in our decision about a year ago to refilm our drawings. We card mount the original silver negative film for the security file. A duplicate diazo film is card mounted for the reference file. This plan is working out to our satisfaction although we still have a lot of refilming and mounting to do.

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(*continued on page 84*)

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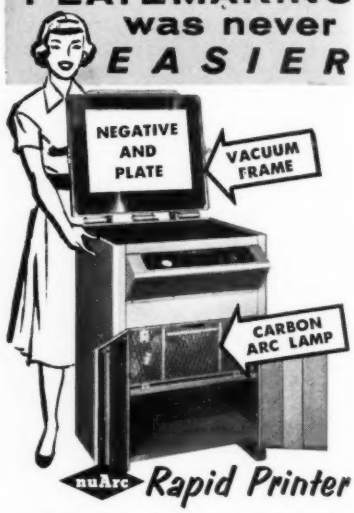

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CRT RECORDING

(*continued from page* 73)

films is the most practical to use for all CRO work because of its versatility and because it will always permit lower intensity settings and smaller apertures.

In existing cameras and standard CRO's even of the highest accelerating potentials, it is almost impossible to record transients of spot speeds of over 2000cm per microsecond without Type 47. The trace shown in Figure 8, indicates that the Type 47 film will record spot speeds up to 4000-cm per microsecond under optimum conditions.

FIGURE 8

Maximum writing rate

The term "maximum writing rate" is used here to indicate the sensitivity of a particular film for recording transients. Maximum writing rate specifies the maximum linear speed of the CRT spot, in a single traverse, that can produce a barely readable record on a film for a particular combination of CRO, camera and settings.

There are three ways of increasing the maximum writing rates of Polaroid Land films. All of these methods can be very useful when a film is being pushed for its maximum sensitivity. Increasing the maximum writing rate will often reveal invisible portions of a fast trace displayed on any phosphors types at various accelerating potentials and CRO settings.

Decreasing the development time Developing Polaroid Land prints only 20 to 30 seconds will about double maximum rate. Twenty seconds is the optimum period. The picture is removed from the back door 20 seconds after pulling the tab. The overall background is considerably lighter and contrast is lowered, but detail can be seen in parts of a fast trace which would effort and could be used whenever development.

This method requires no extra effort and could be used whenever shooting high speed transients.

Prefogging Controlled marginal exposure of the film to a light source before exposure to the trace will increase maximum writing rate two to three times. See Figure 9 contrasting pre-fogging and no pre-fogging. Pre-fogging has been found to be the most effective single

(*continued on page* 78)

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CRT RECORDING

(*continued from page 77*)

method for increasing maximum writing rate.

Pre-fogging does not cause as sharp a drop in contrast as under-development, and it is not necessary to pre-fog enough to lighten the background considerably.

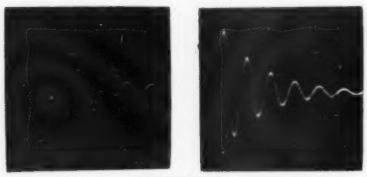

FIGURE 9

A variety of different procedures can be used to pre-fog. A convenient method is to point the camera at standard transparency viewer illuminated with a 15-watt bulb and covered with three or four thicknesses of tissue paper. Expose Type 47 film at f/16 at 1/100. Take care that the camera is far enough away (a foot is sufficient) so that the texture of the tissue paper is out of focus, and yet close enough so that the illuminator covers the entire field of view of the camera.

Other easy methods of pre-fogging can be developed by experiment. You can, for example, point the camera at a light wall with the proper brightness. A reflection brightness reading of 30 candles per square ft. is about the correct level. A handy guide for determining the best combination of exposure and light source is to develop an *un*pre-fogged Type 47 picture for 30 seconds. The background grey level in this picture is about the same density as optimum pre-fogging would create on a picture developed for 60 seconds.

Transillumination When parts of a trace are not quite readable, a print viewed directly over a bright diffused light source such as a 100-watt lamp, will render visible very dim or unreadable traces with surprising clarity. Another technique which may come in handy when a fast trace is not readable is to glance at the negative still in the back of camera. Though it will rapidly fog under light, valuable information is often available.

A still greater incremental increase of maximum writing rate can be achieved by combining the pre-fogging and under-development. To keep the background dark enough and achieve best results, develop for a slightly longer period, 30-35 seconds and use the same prefogging technique described above.

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In general, forty-five seconds is long enough for development of prints of CRO traces. The sixty-second standard development time serves only to build up contrast in the middle grey areas of the picture—a characteristic not important for most CRO traces. Here are some pointers on development times: To record detail, a full sixty-second development time is recommended when details on faint portions of a trace are desired. To increase maximum writing rate, exposure of twenty to thirty seconds will increase maximum writing rate, but will cause a slight loss in trace sharpness and background density. The effect of over-development up to two to three minutes will increase contrast, increase the blackness of the background and eliminate some details of faint portions of a trace. Occasionally, faint undesirable high frequency noise can be eliminated from a photograph by over-development.

Double images

A double image, as seen in Figure 10, is sometimes recorded by cameras using beam splitter mirrors with P-1 or P-2 phosphors. Since these mirrors are designed primarily for use with the P-11 phosphors with blue output, some of the green light from P-1 and P-2 phosphors is reflected from both surfaces of the mirror. A blue filter will eliminate the double trace.

Recording special effects

It is useful to record markers, graticules, data charts, and calibrated wave forms on the same picture as the trace recording. These records are made by exposing both the trace and data at the same time or by exposing the film with extra information before or after recording the trace itself.

Calibration markers Calibration markers for adding time information to a trace are usually either superimposed on the vertical axis of the trace or they are used to modulate the intensity of the trace.

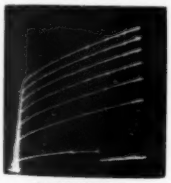

FIGURE 10

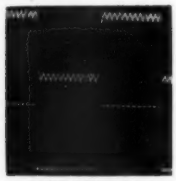

FIGURE 11

Examples are shown in Figure 11, where the top trace has vertical pips added for time interval calibration and the lower trace has Z-axis

(*continued on page* 80)

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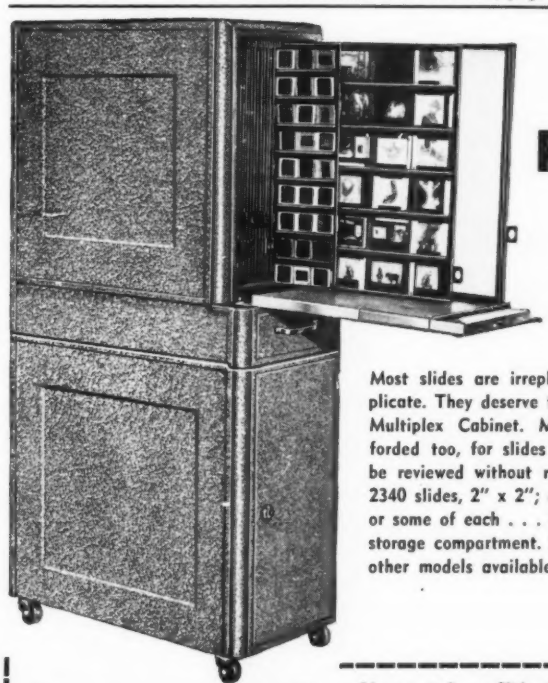

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CRT RECORDING

(*continued from page* 79)

signal input modulating intensity for time calibration. Should the intensity modulation signal not be sufficient to provide noticeable effect on the photograph, improvement is possible by reducing the CRO intensity and increasing the contrast of the Polaroid Land print through increased development to two to three minutes, as compared

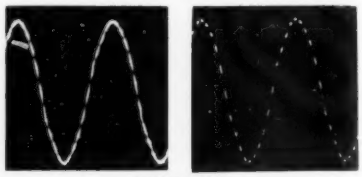

FIGURE 12

in Figure 12. Another interesting technique for using calibration markers is indicated in Figure 13, where an especially long time base had to be recorded in one picture. The horizontal sweep is contracted into a raster which is displayed on the CRT face with time markers.

Graticules Illuminated graticules can usually be recorded with the trace on a single exposure with Type 47 film by turning up the graticule scale brightness and lowering the CRT intensity.

With other less sensitive films than the Type 47, it is usually necessary to make two separate exposures to record both the graticule and the trace. This is especially true when using a P-11 phosphor which has a higher actinic light output (with the intensity at medium setting) than the graticule scale brightness usually has at full intensity. First record the graticule with its illumination turned up and the CRT intensity turned down. Then turn off the graticule and record the trace with CRT intensity at normal setting. Trial and error on your own scope will establish proper relationships very easily.

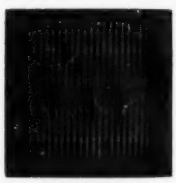

FIGURE 13

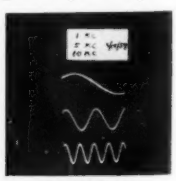

FIGURE 14

Where there is a choice between white or colored graticule illumination, best results are obtained in photographing the white lines.

Care should always be taken that the graticule is in sharp focus because graticule and trace are not in the same object plane. Keep cam-

era apertures to a minimum. Make sure that the glass or plastic plate is positioned so that the lines face the trace and are flush against the CRT.

Data Charts Some oscilloscope record cameras are provided with a ground glass surface on which identifying data can be written with pencil. Internal illumination exposes this data on the film. The data card, as shown in Figure 14, required another exposure. Remember to turn down the intensity of the trace and the graticule scale before exposing the data card to avoid double exposure of the trace. An exposure on Type 47 film of about 1/2 second at f/5.6 is sufficient with the light emitted from two 112 lamps and 1 1/2-volt battery.

Continuously varying patterns A continuously varying pattern often can be "stopped" for study only by a photograph. When using a CRO with built-in beam gate, the driven sweep and external sync controls permit triggering the gate for one sweep of a continuously varying pattern without difficulty. With instruments without built-in beam gates, sometimes the shutter speed can be adjusted to the duration of one sweep, if the sweep speed and the rate of change of the pattern are relatively low.

Notice the difference of a varying x-y signal in Figure 15. The first

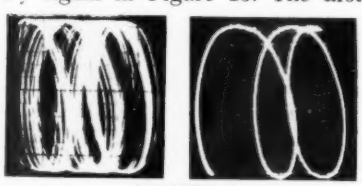

FIGURE 15

trace is blurred because several varying signals were recorded; the second trace was electronically gated to display only one trace for recording by the camera.

Radar Displays Recording the high intensity PPI scope radar returns is very simple and straightforward. Usually a long persistence P-7 phosphor is employed. With an aperture setting at f/11 or f/16, and the shutter open on "B" or "T", a test exposure or two will establish the proper intensity level of both the radar display and the azimuth scale setting. Care should be taken to record only a single complete sweep and to avoid the overlap. Hand controls on the camera shutter are usually sufficient. See Figure 16, illustrations of a PPI display of precipitation (left) and PHI dis-

(*continued on page* 82)

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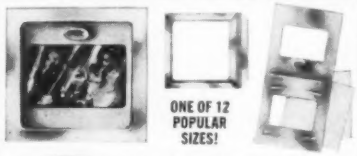

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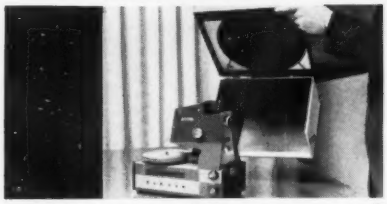

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CRT RECORDING

(*continued from page* 81)

play of a thunder cloud.

Single frame recordings of the A-Scope pattern has limited applica-

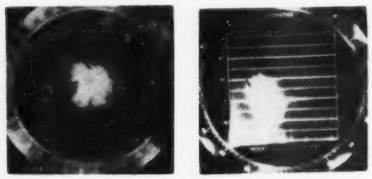

FIGURE 16

tions because the trace is usually varying so rapidly. To record traces on this CRT, usually a P-5 phosphor, open the aperture wide, turn the intensity level of the A-Scope to as high a level as is feasible, and keep exposure time to an absolute minimum.

Most oscilloscope record cameras will mount directly on the standard 5-in. A-Scope flange. For the common 7-in. PPI scope, a special mount should be constructed. To record the full 7-in. as well as the circular azimuth scale, you will have to build your own special radar cameras with Polaroid Land camera backs.

Avoiding fogging

Though undesirable fogging can take place from several sources, in most cases it can be easily eliminated. Fogging usually comes from one of the three general sources: 1) The CRT trace itself. 2) Internal sources within the CRT. 3) Light leaks within the camera.

The most common source of fogging is from the CRT itself. Blooming caused by high intensity traces or over-exposure can cause glow from the entire CRT face and excessive reflection from the walls of the camera tube. Control of this fogging is performed by more careful adjustment of camera settings and CRO intensity settings.

When recording transients, a stationary spot from a CRO with no automatic blanking circuit can cause film fogging. To eliminate fogging from the spot, position spot near, but not beyond, the edge of side of screen. Mask the stationary spot with tape or black opaque paint. Do not move the spot too far off the screen to the side of the tube, or the mask will not cut off the glow from the electronic scattering.

Cathode glow and stray emission are two sources of fog that come from internal parts of the CRT. Cathode glow, shown in Figure 17,

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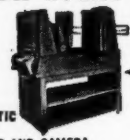

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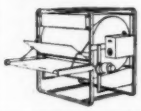

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is caused by the infra-red glow of an incandescent cathode penetrating an unaluminized phosphor screen, and it can cause serious fogging when the shutter is open for long periods of time, such as awaiting the appearance of a random transient. This type of fogging does not occur on cameras which have backs perpendicular to the CRT because the blue reflecting dichroic mirror does not reflect the infra-red glow. A blue filter can help eliminate the glow when it is not practical to use higher accelerating potential CRO's possessing aluminized screens.

The stray emission from electron reflections from deflection plates on some older type oscilloscopes will show a slight glow on the CRT and

FIGURE 17

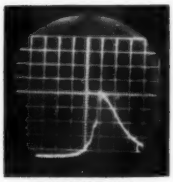

FIGURE 18

can cause fog on the film. Slight adjustments in the position of the electron beam or reduction in the deflection amplitude can usually eliminate such defects.

Fogging from the camera itself results either from stray light through light shields, as shown in Figure 18, where fogging is due to stray light leaking in between the bezel and the cathode ray tube mount. As with cathode glow, this problem occurs when the shutter has to remain open for long periods awaiting a random transient. The only practical answer is to exercise more care in mounting the oscilloscope record camera. Fog can also occur when the operator neglects to close the trap doors in the viewing ports or the camera setting ports before exposure.—THE END

Acknowledgment

The authors of the foregoing article wish to acknowledge the following for contributing the illustrations noted:

Figure 7, AVCO Corporation
Figure 8, Tektronix, Inc.
Figure 13, AVCO Corporation
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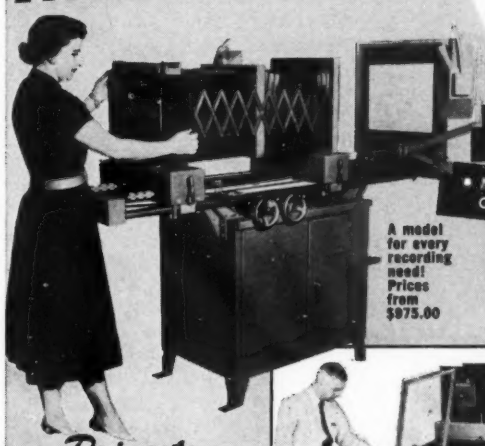

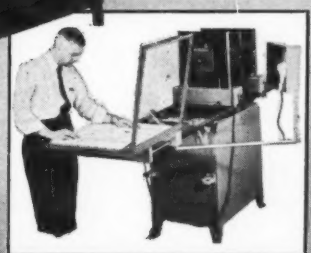

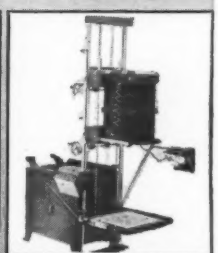

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SWITCH IN TIME

(*continued from page 76*)

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One additional security advantage is derived from making prints on the offset press. At the end of each print run, we feed a rice paper through the press to make a reduced scale transparency. This costs us only the price of the paper. Over a period of several years, we have accumulated a rather complete file of our standard drawings. That file, which is located remotely from our original drawing file gives us a measure of security because of the distance involved. Its further advantage is that it is immediately ready to produce prints when needed.

How does microfilm fit into this print service picture? At the moment, we like our print distribution system so well that we are not apt to substitute films for prints except in isolated areas. However, we do like the idea of making our prints from film; but perhaps in coordination with our present Xerox-Offset processes. We would like to have a camera which would make 12 x 18 offset plates from card mounted microfilm with at least as much flexibility as we now obtain from our 12 x 18 Xerox camera.

From a print service standpoint, there is an additional problem occasioned by working completely from film. When drawings are released by our Engineering Department, we are often required to supply prints to various departments on a "rush" basis. This waiting time would be extended if we were delayed by the film processing and card mounting time. It appears that the first print releases may, even in the future, be made from the original drawings either as Xerox-Offset or whiteprints.

Procedure at Cutler-Hammer

A detailed discussion of procedure is avoided here because much has been printed on the subject. A picture of the flow of the

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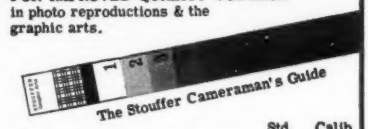

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processing cycle at Cutler-Hammer is shown on Chart No. 2. This procedure is set up to eliminate all clerical listings and records.

All new and revised drawings, released by the various engineering and development groups, go to a control station in the reproduction department where they are grouped according to size for microfilming. With very little delay, the originals are filmed, and then passed along to the print centers. The standard drawings go to the Xerox-Offset process and the special drawings to the whiteprint machines where prints are made for immediate distribution and for the print stock file. As mentioned previously, reduced rice paper transparencies of the standard drawings are made on the offset press and filed in a remotely located storage vault. The original drawings are filed in adjacent storage.

We expose one frame of each original at the time of microfilming. The film is processed by our supplier and a diazo film duplicate is made.

We realize a significant cost reduction by eliminating lists and hand indexing. Our daily filming procedure removes the need for listing prior to filming. The card mounted security film eliminates all finding records and Parts Index records relative to microfilm.

The rolls of silver emulsion film go to our Data Processing Department for indexing. We use a viewer with foot operated film transport. The keypunch operator punches the needed information from the microfilm viewer directly into our Filmsort cards. Another operator "Verify Punches" the same cards from the microfilm viewer, that is, repeats the operation as a proofreading measure. This verification step saves time and waste in the mounting operation.

A duplicate deck of Filmsort cards are made automatically from the original deck. Then both decks are run through an interpreter which prints the index information along the top edge of the cards. This procedure gives us two decks of indexing at about one-fourth the cost of hand indexing.

The cards and film next go back to the microfilm room where we do our film mounting with a manually operated mounter. This can be done quite rapidly by a trained operator. The operator will verify about every tenth card and that is often enough because of the accuracy we get from the indexing system.

The decks of cards bearing the original silver film are filed in the security vault. The diazo film decks go to the Repair Department reference file. The latest films are kept in file and the outdated ones are destroyed.

When enlargements, or blowbacks, are required, we are presently using a manual photographic enlarger. Up until now we have needed very little blow-back. As we step-up our destruction of original drawings, we can expect an increase in the need for blowback and for quick service. We will be obliged to install equipment suitable to handle the service requirements as conditions change.

The uses and proposed uses of microfilm discussed above seem to meet the needs of a company of our size as we foresee them today. Let it be said, though, in view of the rapidly changing field involved here, it is almost foolhardy to state in writing a policy that appears in any way to be fixed. We feel that the course we are following is compatible with the present trend in the development of equipment for the field.

In closing, I want to repeat a thought expressed previously, and one which we need to keep reminding ourselves and our associates. In drafting practices, in print production and in the utilization of microfilm, we must not lose sight of the effect our actions may have on others in the organization, when we cut corners in specific areas. We may show cost savings in these areas but lose many times the amounts elsewhere. Drawings, prints, and microfilm need to be served to the users in an improved manner both as to form and availability. The best possible service of reference material will pay off in the improved production and dispositions of our engineers and designers.—THE END

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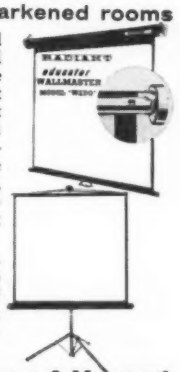

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IND. MOTION PICTURES

(*continued from page 22*)

of cameras. Wear these gloves inside heavy mittens.

In hot weather shooting, the high humidity makes life difficult for the movie maker. Exposed film should be processed as soon as possible as the humidity affects the image on exposed film more severely than unexposed film. If the exposed film must be kept a while before processing, do not place it in a humid air tight can. It should be dessicated first, using a dessicant like Silica-Gel (made by Davidson Chemical), in an air-tight container. When the film is dry, it can then be sealed up and made air tight.

Another enemy encountered under humid conditions is fungus which attacks both film and equipment. Anti-mildew compounds may contain paraformaldehyde. Even a trace of its fumes can badly damage color balance of unexposed color film. Here, the only advice is "keep it dry."

Cool storage is best

At high temperatures (over 80°F), films deteriorate, losing speed, showing more grain, changing color balance, etc. The higher the temperature, the more rapid the deterioration. The cameraman should, if possible, keep his film in a refrigerator or other cool place until he needs it. With the extensive use of food-storage equipment, this is not as difficult as it sounds. Remember, though, to remove the film from the cold storage several hours before it is to be used, letting it warm up slowly to prevent condensation inside the film can.

When storing equipment in hot weather, remove film from the camera overnight, unless you can place camera and film in a dehumidified air-tight box. A mechanical dehumidifier or a chemical dessicant can be used. If the relative humidity is not too high, you can keep camera and film in a well-ventilated "hot closet," a box with a heating element to keep the area warm and dry. It should have holes at top and bottom to permit air to circulate freely, thereby reducing the humidity inside the box.

Cost Estimator

Consolidated Film Industries of New York and Hollywood is offering a handy slide rule-type estimator for 35 and 16mm which automatically estimates running time, footage or cost of film from any one of these three factors. Send requests to 959 Seward St., Hollywood 38, California.

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PHOTO BOOKS IN REVIEW

EYE, FILM AND CAMERA IN COLOR PHOTOGRAPHY, *Ralph M. Evans, John Wiley & Sons, Inc., New York, N. Y., 1959, 410 pages, $8.95.*

An old proverb advises us not to believe everything we see and very little of what we hear. The truth of the latter we can readily appreciate. Whether it's a "fish" story or a bit of gossip, sooner or later we learn of discrepancies between the actual event and the verbal account. But when it comes to vision very few of us realize the vast difference that can exist between reality (the scene) and sight (the mental image). We are taught to believe our senses but, unfortunately, all sensory perception is influenced as much by prior experience as by the physical and other circumstances of a given situation (stimuli).

Much too often photographs fail to please us although they may be reasonably accurate records of the scene. And equally often the medium, or the photographer's competence or both are blamed. In the transition from the physical scene to the photographic record there are, of course, many opportunities for error. These, obviously, can be corrected once they become known. But dissatisfaction because of psychological factors inherent in the observer is much more complex. However, knowing what the differences between the physical scene and the observer's impression of the photograph are likely to be affords the photographer the opportunity to either offset them or utilize them to advantage. And this is the point of Ralph Evans' book. As Director of the Color Technology Division, Eastman Kodak Co., the author has had intimate experience with the technical and psychological aspects of color. The present effort embodies the knowledge gained in 20 years of experience with the subject.

In two detailed chapters Mr. Evans outlines how we and the camera see things. In other chapters he explores the nature of color photography, color and form in photographs, the perception of light and color in photographs and related topics. The technical aspects of how color photography works are not overlooked. The chapter covering this phase also reviews the currently used methods.

The bulk of the information this book contains complements the usual technical "know how." The combination of the two enhances a photographer's ability to avoid many pitfalls and thus produce pictures that convey the intended impression. —H. P. PASCHEL

(*continued on page 97*)

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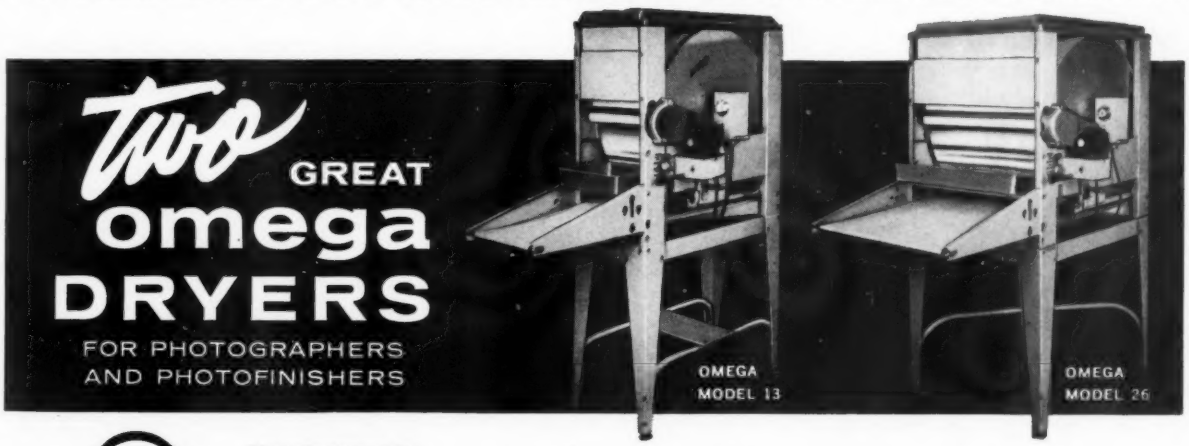

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FREE LITERATURE

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AUDIO-VISUAL

SELECTROSLIDE PROJECTORS 201
Spindler and Sauppe. Illustrated data sheets describe the Selectroslide projectors for automatic slide presentations.

SLIDE FILE 202
Burke & James, Inc. Illustrated price sheet describes the Vue-File slide file for 2 x 2-in. slides. May be used as a note book file card, drawer file card or slide mailer.

SOUND PROJECTORS 203
Bell & Howell. 16-page booklet discusses many of the uses of sound movies and sound projectors in business today. A check list of significant points for the prospective buyer of sound projectors is included.

RECORDED MUSIC 206
Boosey and Hawkes. 24-page catalog of recorded music for motion pictures and audio-visual presentations.

REAR-VIEW FILMSTRIP PROJECTOR 207
C.O.C Industrial. Specification sheet for C.O.C. Examiner rear-view projector.

STORAGE EQUIPMENT 204
Smith System Mfg. Co. Catalog sheet lists film storage racks for film reels, cabinets for slides and filmstrips, cabinets for tapes and projection charts.

PICTUREPHONE 205
McClure Projectors, Inc. Illustrated brochure includes specifications and prices for sound filmstrip projectors.

VISULITE 208
Tecnifax Corp. Illustrated brochure describes the portable illuminated transparency viewer with a 13 3/4 x 18¾-in. screen housed in a luggage case. Includes price.

CAMERA & LENS

ROTI STORY 210
Perkin-Elmer Corp. 12-page brochure describes three Recording Optical Tracking Instrument systems, ROTI, manufactured by the Perkin-Elmer Corp. for missile tracking.

VOUGHT FLIGHT ANALYZER 211
Vought Co. Specification sheet describes the VFA-25 16mm flight analyzer which furnishes information by triangulation.

PANORAMIC AERIAL CAMERA 212
Perkin-Elmer Corp. 8-page brochure gives specifications and discusses the operation of the new 70mm panoramic camera for 180° aerial reconnaisance.

MAGNIFAX CAMERA 213
Beckman & Whitely. Two specification sheets describe the Model 333 Magnifax high-speed camera which operates at speeds up to 3,200 frames per second.

35MM VIEW CAMERA 214
Fairchild Camera and Instrument Corp. 4-page brochure describes the K-1 Monobar 35mm view camera which Fairchild is handling exclusively in this country. Includes prices for camera, tripod, etc.

CALUMET VIEW CAMERAS 215
Calumet Mfg. Co. Two illustrated brochures describe the all metal Calumet 4 x 5 and 8 x 10 view cameras. Specifications and prices included.

PHOTOMICROGRAPHIC CAMERA 216
American Optical Co. 6-page illustrated brochure describes the AO Spencer photomicrographic camera and accessories.

OPTIKA IIa 217
Seymor's. 4-page brochure gives specifications of the Optika IIa single-lens reflex camera which uses 120 film size.

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Take a look at what you want on the big viewing screen

The new THERMO-FAX "Filmac 100" Reader-Printer makes microfilm so easy to use—makes microfilm practical for use now in everyday business. When your files are reduced to space-saving film, the only equipment you need to make them usable daily is the "Filmac 100" Reader-Printer.

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Get more information. Circle 472, page 91

EQUIPMENT

ARKAY CATALOG 218
Arkay Corp. 8-page catalog of stainless steel developing tanks, sinks, print washers, temp. controlled sinks and print driers.

GOLDEN STARLITER 400 219
Scheibe Engineering, Inc. 4-page folder describes the Golden Starliter 400 electronic flash unit with automatic voltage stabilization and 400 watt-seconds power. Unit has 5-power selector switch—25, 50, 100, 200 and 400 watt-seconds.

PHOTODRAWINGS 220
LogEtronics, Inc. 4-page illustrated folder explains the use and advantages of the LogEtronics enlarging system for making photodrawings.

OSCAR FISHER SINKS 221
Oscar Fisher Co., Inc. Specification sheet for Fisher line of stainless steel sinks. Includes sizes and description of construction methods employed.

SEAMLESS PAPER HOLDER 222
Krank-N-Roll Mfg. Co. Illustrated price sheet describes the new rotary Skydrop for supporting four different rolls of seamless paper background material.

TRAY ROCKER 223
Bald Eagle Corp. Specification sheet describes the Bald Eagle automatic tray rocker for continuous agitation. Varying dual motion is said to eliminate patterns.

INTERCHRON TIMER 224
Specification sheet for the Interchron timer which is capable of up to 16 sequential time intervals. Each interval can be set from 10 sec. to 30 min. in length with 10-sec. scale division steps.

DURST ENLARGER 225
Durst Inc. 6-page brochure describes the Laborator 3s enlarger for 35mm to 5 x 7-in. negative. Unit is also suitable for copying, reducing and distortion control.

FLOATING ACTION TRIPOD 226
Davis & Sanford Co. Illustrated brochure describes the floating action tripod for studio and movie cameras. Accessories listed include pan head, extension sections, side arms, dolly etc.

TRI-FILM PROCESSOR 227
Canadian Applied Research Ltd. 12-page brochure describes the Automatic Tri-Film processor for 16, 35 and 70mm film processing.

GRAPHIC ARTS

COPYING MACHINE COMPARATOR 228
Minnesota Mining and Mfg. Co. A slide rule comparator, listing details on office copying machines made by ten different manufacturers contains information on machine and paper costs, types of copying processes, number of copies possible per minute and details on other categories.

AUTOMATIC JACKET FILLER 230
Remington Rand. Catalog sheet for the Film-A-Record automatic jacket filler that feeds, cuts and inserts microfilm into protective jackets.

ARC LAMPS 231
NuArc Co., Inc. 4-page brochure describes the motor driven NuArc lamps and accessories.

ANSCO MATERIALS 232
Ansco. 4-page folder and price sheet lists Ansco's graphic arts materials. Handy chart lists sizes and quantities in which films are available.

KODAK Q SHEET 233
Eastman Kodak Co. 8-page booklet, *Filter Control of Screen Positives Made with the Kodak Magenta Contact Screen.* Punched to fit Kodak *Graphic Arts Handbook.*

WASHABLE TRACINGS 234
Keuffel & Esser Co. 4-page folder with sample sheet of Herculene drafting film. This Mylar film drafting material may be washed for greater life.

MICROFILM READER-PRINTER 235
Minnesota Mining and Mfg. Co. 4-page brochure tells the story of the Thermo-Fax microfilm reader-printer which makes enlarged copies in 8 sec.

CORMAC COPIER LINE 236
Cormac Photocopy Corp. Printed file folder lists the Cormac 1960 line of photocopy machines.

THERMO-FAX Reader-Printer

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ROBERTSON CAMERAS 237
Robertson Photo-Mechanix. Two illustrated brochures give specifications and describe operation of the Robertson Meteorite and Econo-Mite cameras for use with the Kodak Ektalith method of making offset masters.

3M LITHOGRAPHIC PLATES 238
Minnesota Mining and Mfg. Co. 4-page brochure describes the three new presensitized aluminum plates recently introduced by this firm.

POLYCHROME CATALOG 239
Polychrome Corp. 18-page catalog of plates, inks and other offset supplies. Includes information regarding use of mechanical negative stencil material and Polychrome's Graphic Transfer unit for making offset plates with a Verifax Copier.

CAMART PRODUCTS 240
The Camera Mart Inc. 8-page catalog of motion picture editing equipment includes sound readers, editing tables, film bins, electric film timers, etc.

KREONITE PRICE LIST 229
Kreonite Inc. 4-page price list and specifications of Kreonite fiberglass sinks, dot etch tables, process negative washers and related accessories.

MOTION PICTURES

35MM PROJECTOR 262
S.O.S. Cinema Supply Corp. Specification sheet describes the operating procedures and power requirements for the X-Raydiola 35mm projector with variable speed drive, forward and reverse plus single frame projection.

HALF-FRAME CAMERA 263
Traid Corporation. Product profile sheet describes the 16mm Bell & Howell 917-F half-frame camera.

PROCESSING MACHINES 264
Ana-Tec Inc. 4-page brochure describes the Multi-Matic Filmaster automatic film processing machines for 16, 35 and 70mm black-and-white and color films. Includes the Mobilmaster trailer unit.

COST ESTIMATOR 265
Consolidated Film Industries. Slide-rule-type estimator for 16 and 35mm which automatically estimates running time, footage or cost of film from any one of these factors is offered by this New York and California firm.

PRESTO-SPLICER 241
Prestoseal Mfg. Corp. 4-page price sheet includes description of the Miracle Presto-Splicer which employs the new butt-weld method. Models are available for 16, 35, 65 and 70mm film sizes.

VIEWER AND SOUND READER 242
S.O.S. Cinema Supply Corp. 4-page folder gives specifications of the Ediola action viewer and sound reader for 16 or 35mm film.

FILM REPAIR BLOCKS 244
Florman & Babb, Inc. 6-page brochure explains the use of the F&B film repair and butt-splicing blocks with Magic Mylar tape. Includes prices.

STOP-MOTION PROJECTOR 243
Red Lake Laboratories. Illustrated specification sheet for the Red Lake 35mm stop-motion projector. Projector has both forward and reverse variable speed drive giving 8 to 24 fps.

FO-RO FLUID TRIPOD HEAD 261
Forbes-Robinson, Inc. Specification sheet describes the Forbes-Robinson Model 75 Fluid Tripod head with a 75-lb. weight capacity.

RECORDER/REPRODUCER 543
Magnasync Corporation. Illustrated price sheet explains the use of the Nomad 7-lb. recorder/reproducer for lip sync and narrative recording on location with most 16mm motion picture cameras.

FOG MAKER 542
Mole-Richardson Co. Article reprinted from *American Cinematographer* magazine describes the fog making machine and its use in motion picture productions.

SERVICES

MOTION PICTURE LAB 246
Hytone Film Lab. 8-page producer's price list for processing black-and-white and color motion picture film. Editing, sound recording and other special services offered by this Iowa outfit are included.

HOLLYWOOD VALLEY LAB 247
Hollywood Valley Film Laboratories, Inc. Five price sheets for complete 8 and 16mm film services offered by this Studio City lab. Includes both black-and-white and color work.

WESTERN CINE SERVICE 248
Western Cine Service. 16-page producer's price list of complete 16mm cine services offered by this Denver lab. A price card of sound recording, editing and duplicating services on discs and ¼-in. tapes is also included.

DENVER COLOR LAB 249
Roundtree Color Lab. Two brochures offered by this Denver outfit include price schedules for complete color services for the still photographer.

D.C. MOVIE SERVICE 245
Byron Motion Pictures. 24-page booklet describes the motion picture laboratory and studio facilities offered by this Washington, D.C. firm.

PHOTO MURALS 540
Dan P. Watts Photo Murals. Complete price list and services on photo murals and custom enlarging.

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MOTION PICTURE PROCESSING 250
General Film Laboratories. 16-page illustrated booklet describes the complete motion picture color processing services offered by this Kansas City and Hollywood outfit.

MISSOURI CINE LAB 251
Calvin Productions, Inc. 4-page price list for 16mm black-and-white and color processing services offered by this Kansas City Mo. firm.

SUPPLIES

METALPHOTO PLATES 252
Metalphoto Corp. 8-page manual explains processing procedures for reproducing permanent images on aluminum plates.

SELF-SEALING PLASTICS 253
The Carr Corp. 4-page brochure describes the Plain-vu plastic lamination method which does not require the use of machines.

ILFORD FILMS 254
Ilford Inc. Illustrated brochure describes characteristics of Ilford photographic roll films.

PEERLESS PHOTOCOPY MATERIALS 255
Peerless Photo Products, Inc. 8-page booklet lists line of Peerless photocopy papers.

SUPER ANSCOCHROME 6500 256
Ansco. 4-page color folder gives complete exposure and processing data for Ansco's new Super Anscochrome 6500 sheet film for electronic flash. Film has an E.I. of 100.

FILM CLEANER 257
Ampco Chemical Division. Illustrated folder describes the Ampco Film-New film conditioner which cleans, protects and lubricates old and new motion picture film.

LIQUID NEOPRENE 258
Pro-Chem Co. Specification sheets describe the Pro-Chem liquid air-curing neoprene protective coating which may be suitable for the lab or darkroom.

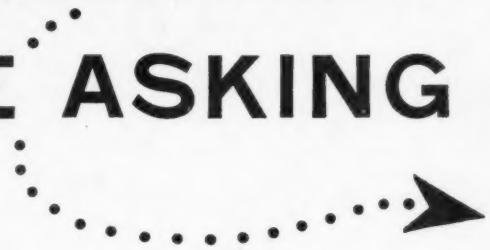
DARKROOM TIPS 259
Peerless Photo Products, Inc. Handy chart suitable for wall hanging lists many causes and preventive measures for print problems, from Abrasion to White Spots.

SILVERCEL BATTERIES 260
Yardney Electric Corp. 8-page bulletin describes the Silvercel batteries for aircraft installations where miniaturization is an important consideration.

CHEMICAL CATALOG
Philip A. Hunt Co. 48-page catalog of Hunt Photographic and Graphic Arts Chemicals. Includes prices. Requests for this publication must be made on company letterhead.

FREESTYLE'S CATALOG 209
Freestyle Sales Co. 20-page catalog of film, paper and photographic supplies. This catalog is chock full of items for the still and motion picture photographer.

YOURS FOR THE ASKING



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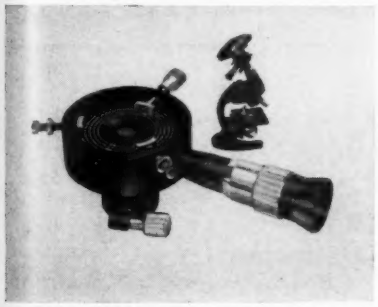
NEW PRODUCTS

For additional information on any new product circle the appropriate number on the readers' service card, page 91.

REDI-FIX CONCENTRATE 101
A single fixer-hardener concentrate solution called Redi-Fix for papers has been introduced by L. B. Russell Chemicals. Each 5-gal. container yields 40 gals. of working solution. Redi-Fix is said to fix 350 or more 8 x 10-in. sheets per gal. of solution.

RAPID FILM DRYING 102
A chemical designed to dry and condition processed films is Unidri, announced by the Cormac Chemical Corp. After washing, film is immersed in Unidri for 2 min., with gentle agitation and then hung up to dry. The Unidri solution is said to dry film quickly, make it dust repellent due to antistatic action, and leave it pliable.

MICRO'DAPTER 103
Layfayette Radio Inc. recently announced a coupling unit which permits still and motion picture cameras to be attached to microscopes and telescopes. All exposures are made with the camera set at infinity. The focusing necessary is achieved by



sighting through an integral telescope viewer that is part of the Micro'dapter. Cross hairs are superimposed on the image for centering. An internal shutter shunts all the light to the telescope for viewing or to the camera lens when ready for exposure. Price is $19.75 complete with lateral viewing telescope, accessory sleeves and fitted case.

PROCESSING MACHINES 111
A line of film processing machines was introduced by Ana-Tec Inc. The line includes the Archival Micromaster, microfilm processor; Multimaster, processor of black-and-white positives, negatives, and reversals; Colormaster, processor of color positives, negatives and reversals; Mobilmaster, self-contained mobile laboratory for all film processing; Portamaster Darkroom, attachable portable darkroom for any daylight operation; and Trackmaster, special high-speed machine for use at race tracks or other events requiring immediate results.

The machines feature non-aerating constant head solution replenishers, leak-proof circulating turbulating chemical pumps, and automatic hold-over solution temperature controls.

ILFORD IMPROVED FP3 FILM 104
A new improved version of Ilford Inc.'s medium speed panchromatic FP3 35mm film e.i. 64 daylight, has recently been announced. Available only in 35mm, the new film is said to offer finer grain and better definition than the old FP3 without any loss in speed.

SUPER ANSCOCHROME 106
A color film specifically balanced for electronic flash is Ansco's new Super Anscochrome 6500 sheet film. The film has and E.I. of 100. No filtration is said to be necessary with most professional electronic flash units.

KODAK ER FILM
The rceently introduced Kodak Color Reversal Films SO 260 and SO 270 will now be designated Kodak Ektachrome ER Film Daylight Type and Kodak Ektachrome ER Film, Type B. Although the name has been changed the product remains the same according to the manufacturer. The Daylight Type film has an E.I. of 160 and the Type B, E.I. of 100. Both ER films are available in 16, 35 and 70mm sizes.

MICROFILM PRINT PAPER 107
A silver photographic stabilization process named Rollacopy for making readable and reproducible enlarged prints from microfilm has been announced by Bauchet & Cie of France. Rollacopy paper can be printed in any overhead microfilm reader without the use of a darkroom. Exposure times are between 1 and 30 sec. A developing unit takes care of development and stabilization of the prints in about 10 sec. Rollacopy paper is available on opaque and translucent base stock. Rollacopy is being introduced in the U.S. and Canada by Andrews Paper & Chemical Co.

POCKET MICROFILM VIEWER 108
A pocket microfilm reader of 10X power has recently been developed by the Taylor-Merchant Corp. The unit is made of laminated card stock with a built-in focus device that allows the entire unit to fold flat (¾-in.) and fit into a plastic wallet. The 10X power glass optics are said to provide minimum peripheral distortion and maximum field of view. The reader features vertical or horizontal scanning. This is accomplished by moving the lens housing along built-in tracks for vertical scanning and moving the microfilm itself in a horizontal plane for horizontal scanning. Price of the unit will be approximately $2.

CAMERA LUCIKON 24 145
Featuring a special wide-angle lens that makes enlargements and reductions to 233 per cent is the Lucikon 24 which has just been announced by M. P. Goodkin Co. The compact unit requires 28 x 60 in. of floor space and can be used inside or outside a darkroom. Balanced lighting is said to result from the fact that lights move with the copy. A self-focusing vacuum back equipped with adjustments for various film sizes is provided as standard equipment.

BLACK ALPA 35MM CAMERAS 146
The Alpa b Swiss single-lens reflex 35mm camera can now be supplied with an all black finish, announced Karl Heitz. Prices will remain identical as chrome finished models.

SWISS LITHO FILM 147
A plasticized base is used on the ortho-chromatic litho film, Typon, introduced by the Vero-Dot Film & Chemical Corp. Due to its dense background, over 60 per cent opaquing time is said to be eliminated. The film is said to lie flat and can be used with all standard litho developers and fixers.

BRANDYWINE PRODUCTS 144
A thermoplastic mounting cement that permanently bonds photo prints to paper, wood, glass, leather or metal and a dry, non-staining lubricant for delicate camera parts are two new aerosol spray aids recently announced by Brandywine Photo Chemicals Co.

Spray-Mount is sprayed on the back of the photoprints and then permanently bonded with a flat-iron, at a temperature no higher than 220° F. Price: $1.59 for 8-oz. can.

Dry Lube is said to be non-staining non-toxic, inert, clean, dry and easy to use. It leaves a film which protects against rust and corrosion and is not affected by temperature according to the manufacturer. Price: $1.49 for 6-oz. spray can.

KERR CELL CAMERA 126
Effective exposures of 5 millimicroseconds or longer with no moving parts are said to be possible with the new Model KSC-51 Kerr Cell camera recently introduced by Electro Optical Instruments, Inc. This high-speed shutter employs two Polaroid filters which are normally closed to prevent light transmission. Located between these filters is the hermetically sealed Kerr Cell, filled with nitrobenzene and in which a pair of planar electrodes are immersed. Application of a voltage pulse to the planar electrodes induces birefringence of the nitrobenzene fluid. The action of the birefrigence alters the polarized light passed by the first polarized filter to permit passage by the second filter on to a photographic film. The duration of the transmitting condition is controlled by the voltage pulse time. A synchronizing pulse generator is available. The basic recording unit is a Graflex Crown Graphic. A Polaroid Land attachment is also available as an accessory.

ULTRABLITZ METEOR II 137
A 100-watt-second electronic flash unit which features monitorized transistor cir-cuits is said to produce consistent light output all the time according to the manufacturer. A pocket-sized rechargeable battery booster is also said to double the amount of shots on a single charge. Other

(*continued on page* 94)

features include an automatic cut-off switch that "prevents power drain;" variable beam reflector; rechargeable nickel cadmium batteries; built-in charger that charges batteries overnight from standard household AC outlet and provision for AC operation if desired. The unit weighs about 3 lbs. Price: $99.50; Battery Booster, $34.95; sidelight extension, $29.95; photocell, $26.95.

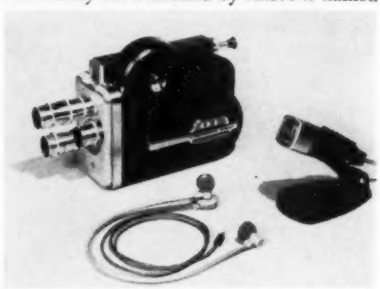
ONE-NEGATIVE PHOTOCOPYING 138
The new Hunter Royal Scot copying machine produces one-step negative or two-step positive photocopies. The machine has an exposure speed of 70 in. per min. and a development speed of 56 in. per min. It produces a negative which is capable of producing numberless copies of any mark on any paper up to 12 in. wide, according to the manufacturer. The unit has simple dial exposure controls and is designed for daylight operation. Once the negative is made copies are said to cost approximately 5¢ a copy since only one sheet of paper is necessary. The machine will also produce correct reading negatives if so desired.

NEW FADE ATTACHMENT 139
A wider range of fade lengths (from 17 to 160 frames) is available for the PAR fade attachment for Bell & Howell models J-JC and D-DC continuous printers. Any of the following fade lengths are available in both 3-speed and 5-speed versions of either the 16mm or 35mm units: 17, 20, 25, 30, 40, 50, 60, 75, 90, 120, 140 and 160. 3-speed units can be converted to 5-speed at the factory. The unit is also said to be compatible with available magnetic cueing and automatic filter changers.

HEAVY-DUTY CAMERA STAND 140
Developed initially for use with the Beckman & Whitley Magnifax High-Speed Motion Picture Camera is the Model 335 Stand recently announced by Beckman & Whitley, Inc. The unit which weighs 43 lbs. and stands 61 in. high, provides camera-platform adjustments from 14 to 62 in. above floor level. Two standard tripod threads on ¼ and ⅜-in. thumb screws are located on the camera platform for securing various instruments. The platform has a crank-operated rack and pinion elevating adjustment and rotary mounting which permits 90° of rotary motion in either direction. The stand is recommended for use with instruments weighting between 20 and 40 lbs.

SPEEDROL APPLICATOR 135
A new unit for application of Ecco antistatic cleaner and all cleaners and conditioners to 8, 16 and 35mm motion picture and strip film is the Speedrol which has been announced by Electro-Chemical Products Corp. Features of the Speedrol are an unbreakable polyethylene fluid feed cup; a micrometer feed valve and sight-feed gauge; Teflon rollers which guide the film and lint free, double-wound flannel rolls which apply the cleaner.

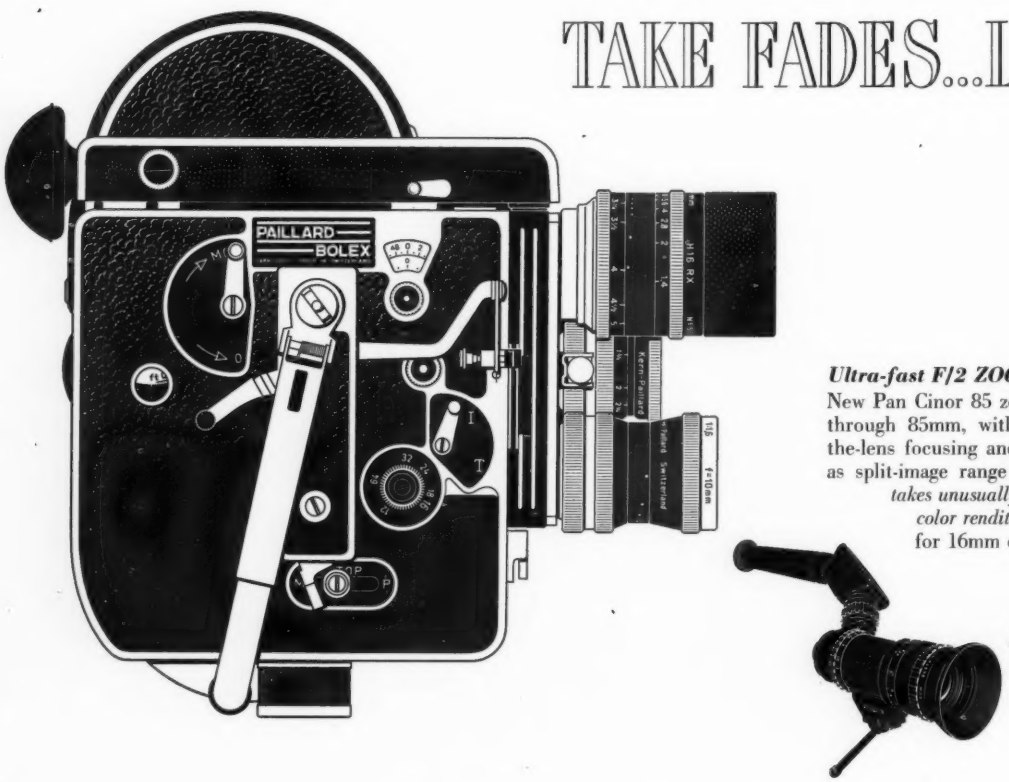
8MM SOUND MOVIE CAMERA 110
A transistorized 8mm sound movie camera called the Cinephonic Eight was recently introduced by the Fairchild Camera and Instrument Corp. along with an 8mm sound projector. The new color film made exclusively for Fairchild by Ansco is named



Fairchild Cinephonic Film and has a 25 mil magnetic stripe to record the sound.

The camera lists for $239.50 as shown with its own microphone and headset for monitoring sound volume. The companion sound projector, which also can record new sound, is priced at $249.50.

CONTACT SCREENS 136
110 and 200 line halftone screens in sizes from 8 x 10 to 23 x 29 in. have been announced by Caprock Developments. The 200-line ruling is said to be the finest ruling presently available in contact screens will interest those lithographers who use projection methods.



TAKE FADES...LAPS...

Ultra-fast F/2 ZOOM LENS
New Pan Cinor 85 zooms from 17mm through 85mm, with reflex through-the-lens focusing and viewing as well as split-image range finder. *This lens takes unusually sharp detail and color rendition.* Has C-mount for 16mm cameras. $420.00.

All prices include Federal Excise Tax where applicable.

Get more information. Circle 487, page 91

MICROFILM PACKAGE 109

A microfilm package plan that combines a camera, film, Universal Processor, Uni-Kards, and reader has just been announced by Remington Rand Division of Sperry Rand Corp. Known as the Film-a-Record Micro-Station Package Plan, it constitutes a complete industrial and engineering microfilm department. The camera is a power-driven, 9-position, planetary unit which can reduce 15 x 21-in. drawings 12 times and 36 x 47-in. drawings 29 times. A light meter is included with the camera. The processor is said to be a new type that automatically develops, fixes, washes, and dries 16, 35 and 70mm film interchangeably of any length up to 100 ft. Designed for daylight operation a 100-ft. of film can be completely processed in less than half an hour.

The Uni-Kard has an acetate jacket which makes it possible to file and protect individual images. Each jacket has room for five lines of indexing and conforms to the standard MIB size for filing convenience. Five thousand jackets are included with the package.

The reader has an 18 x 24-in. screen that transmits an entire film image. It accepts any card or jacket up to 5 x 8-in. and can be adapted for roll film if necessary. Price: $7,295 for complete system.

VOIGTLANDER-ZOOMAR LENS . 142

A Voigtlander-Zoomar lens specially fitted for the Exakta 35mm camera has been announced by H. A. Bohm & Co. Price: $335.

MINUTE MAN OSCILLOTRON 105

A new oscilloscope recording camera featuring a Polaroid Land back is the Minute Man Oscillotron recently announced by Beattie-Coleman. The unit may be attached to any 5-in. oscilloscope. Wollensak 75mm f/2.8, f/1.9 standard or f/1.9 flat-field lenses are interchangeable. Of modular design, it can instantly be converted to record a wide range of object-to-image ratios. A

list of accessories available include: binocular viewing hood; adapter to record up to 10 traces on a single frame; 35mm pulse camera; 35mm continuous motion magazine; data chamber with watch, platen and counter; data card to record in frame; external focusing control; electric shutter actuator. Price of basic unit is $250.

HICO-LITE FLASH UNIT 164

A 200-watt-second electronic flash unit that incorporates a voltage regulator, which is said to insure uniformity from the first to the hundreth shot, is the Hico-Lite Model K. The total number of shots on full power per battery charge is 130. A 50-degree beam is provided and the guide number is 70 for Kodachrome.

Voltage regulation is accomplished by means of a 3-transistor circuit that is said to eliminate battery drain by shutting off the charging circuit except for brief periods to keep the capacitors charged to a constant voltage. A rechargeable 6-volt nickel-cadmium battery may be charged from the built-in charger. The circuits for AC operation are also built-in.

Controls and dual lamp head outlets are on the top of the power pack. ¼, ½, ¾ or full light output may be selected. Recycling time on full power is 11 sec. Weight of the unit is 8 lbs., 6 oz. Price: $289.50.

KUTRIMMER 165

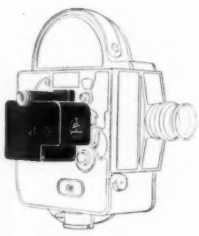
A 32-in. Kutrimmer—combination paper cutter and trimmer—has been added to the line and is now available in both a table and floor model according to the Michael Lith Sales Corp. The Kutrimmer features a measuring device for multiple cuts, and a hand clamp which can be swung aside when necessary. The unit may be hand or foot operated. The new model is said to be a heavy duty unit capable of cutting linoleum, heavy board, thin soft metals and thin plywood, as well as paper stock.

UNIBATH QUARTS AND GALLONS 133

Unibath, the single solution combined developer and fixer, is now being made available in quart and gallon size liquid concentrate. Price per quart of CC-1 and CC-2 is $3.95; $4.35 for CC-3. Gallons are $13.50 and $14.90 respectively.

ALL EFFECTS WITH NEW BOLEX REFLEX

New variable shutter on Bolex 16mm Reflex puts fades at your fingertips. Hand backwinding for dissolves. Parallax-free through-the-lens viewing and focusing while shooting. Footage and frame counters . . . speeds 12 to 64 fps . . . settings for time exposure, single frame and continuous run . . . many other extras. (*Automatic* REXOFADER *shown on camera is a new push-button control that times fades,* optional at only $37.50.) With Lytar 25mm f/1.8 lens, the Bolex H-16 REX is only $400. (Lenses shown optional at extra cost.) Write Department BPM3 for literature and name of nearest dealer.



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Get more information. Circle 487, page 91

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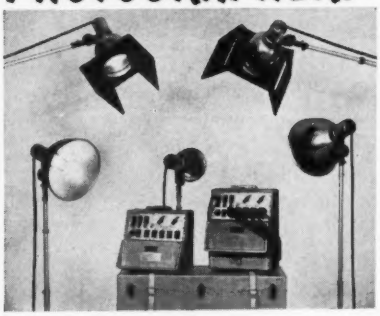
FOR PHOTOGRAPHERS



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THE PUSH

(*continued from page 54*)

Chemical means such as bathing the unexposed film in ammonia or mercury vapors are also known. From a practical standpoint, the objections to such means include: 1) Mercury vapor is very dangerous, 2) additional handling, 3) the propensity toward fog, 4) the fact that the effect is only temporary and may be inconsistent. These are covered in photographic texts, and detailed instructions are given by manufacturers when they feel the techniques are particularly applicable, such as scientific plates.

After development

Post-development treatment is also worthy of mention. In most cases this cannot result in any additional effective speed, but it may greatly enhance the "readability" of the information which the film has recorded, by increasing its contrast or merely raising its printing density.

One of these is recopying the image on a suitable material. A veteran newspaperman recalls shooting football in near zero visibility on glass plates. Following development and drying, the plates were contact printed on plates until finally there was enough contrast to make a paper print.

In motion picture work negative processing offers a basically faster inherent speed than reversal processing. In addition, there is a chance to adjust for deficiencies in a "pushed" negative as best can with the print film.

Intensification has much the same purpose and result as recopying. A quinone thiosulfate intensifier, Kodak IN-6, has attracted the most attention in this particular application. Its formula may be found in the Photo-Lab-Index.

Experiment in a package

As a final note, some mention should be made of a product in which much of the knowledge of increased film speed is offered in a proprietary bundle, namely Polaroid Land Type 47 film. Basically this system utilizes a fast film, a vigorous developer and a reversal transfer which enhances the contrast of the original. No one would seriously contend that it is the ultimate in film speed, but where an equivalent to E. I. 3000 is required. the photographer only occasionally involved in "pushing" his film would be doing well to surpass the results of the Polaroid research and development staff.—THE END

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PHOTO BOOKS IN REVIEW

(*continued from page 87*)

THE GRAPHIC ARTS HANDBOOK, *Du Pont Photo Products Dept., Wilmington, Del., 1960, $6.50.*

The diversity of information the average technician should know about the sensitive material he uses can no longer be satisfied by the data sheets included in the packing, or by the simple pamphlets distributed by the manufacturers. The variety of uses and techniques employed with any given material is so vast that detailed information relating to products and practices becomes voluminous. Whether they like or not, providing the consumer with adequate knowledge about their products has forced most photographic manufacturers into the publishing business. The latest addition to the growing list of "handbooks" is a two-volume, loose-leaf book containing the latest information about Du Pont photographic materials and the related processes and techniques currently used in the graphic arts.

The first and current edition has three basic sections: a brief outline of the development of Cronar film base; a technical data section on the complete line of Du Pont graphic arts products; and a useful and varied technical section devoted to process and technique. The latter covers such topics as "Color Separation and Masking for Reflection Copy," a similar treatment for transparency copy, printed curcuits, chemical reversal, camera flare, etc. Included in this volume is a color control guide, a 13-step grey scale and a supply of gummed register marks.

The Graphic Arts Handbook is well-illustrated and has been prepared by the cooperative efforts of Du Pont personnel and many practical and competent technicians from within the graphic arts industry. The color separation and masking section, for example, includes an outline of the technique developed by the Lithographic Technical Foundation adjusted to the characteristics of Du Pont materials. Another technique is an adaption of the system worked out by Gravure Research, Inc.

Published by the Du Pont Photo Products Dept., the *Graphic Arts Handbook* will be available early this year through dealers in the United States at $6.50 for the two volumes. This is one book that promises to keep up-to-date since the publishers propose to furnish hand-

(*continued on page 98*)

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Get more information. Circle 434, page 91

GUIDING LIGHT

(*continued from page* 43)

fier. If lines are washed out, if there are scratches or if there are dust spots, the plate is rejected. If the plate passes, it is carefully aligned and mounted in the plate holder for insertion into the Monopol.

In addition to the plate itself, Grant makes a 6 x 18-in. print of the drawing on Kodalith Ortho. This is given to the operator so that he can check his machine during the actual cutting process.

In use, the mounted plate is inserted into a compartment of the control console. The operator aligns the light beam on the index mark and also places the flame-tipped outrigger at the proper place on the steel plate. Two plates can be cut simultaneously and the Monopol will take up to 10 x 40-ft. sizes. Once the adjustments are completed, the operator places his machine on "automatic" and the light beam, automatically following the thin lines on the negative, guides the flame-cutters on the steel.

This method not only eliminates the costly mold loft (where wooden templates, the same size as the steel section, were made to guide cutters) but reduces error which is always present in human—as distinguished from automatic—operations. American shipbuilding, always under a cost disadvantage compared with foreign yards, can now meet cost competition with greater efficiency, Sun officials say. The Monopol is photo methods applied to industry with a vengeance.—THE END

PHOTO BOOKS IN REVIEW

(*continued from page* 97)

book owners with new and supplemental material as it becomes available. This latter service is doubly valuable since it will be provided at no extra cost.—H. P. PASCHEL

TV TAPE COMMERCIALS, *Harry Wayne McMahan, Hastings House, Inc., N. Y. 1960, 110 pages, $4.50.* Mr. McMahan, an advertising writer, producer, administrator and "creative consultant" argues for the use of Videotape recording in making TV commercials. Of interest to technically inclined communication workers are chapters 6-8, "How Tape Works," "How to Use Multi-Recorder Installations for Commercials," and "How to Use 1-Recorder Installations for Commercials." Chapter 6 includes a brief history of Videotape and its applications. The author's style is as pointed as a commercial itself.—W. H.

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Get more information. Circle 490, page 91

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Get more information. Circle 455, page 91

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Ansco

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6500

Get more information. Circle 404, page 91

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